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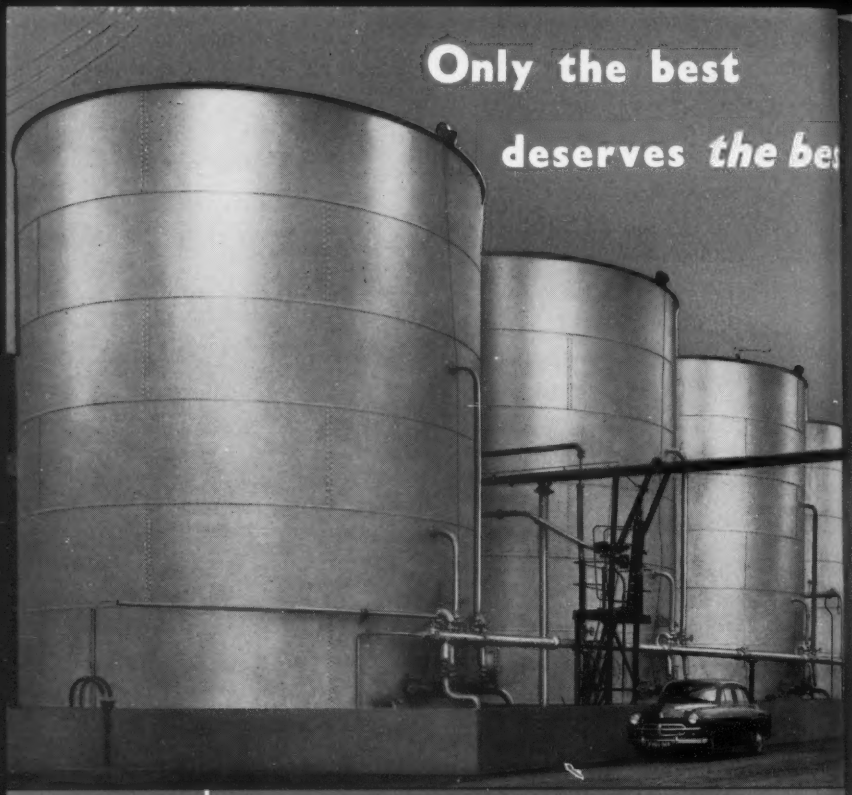

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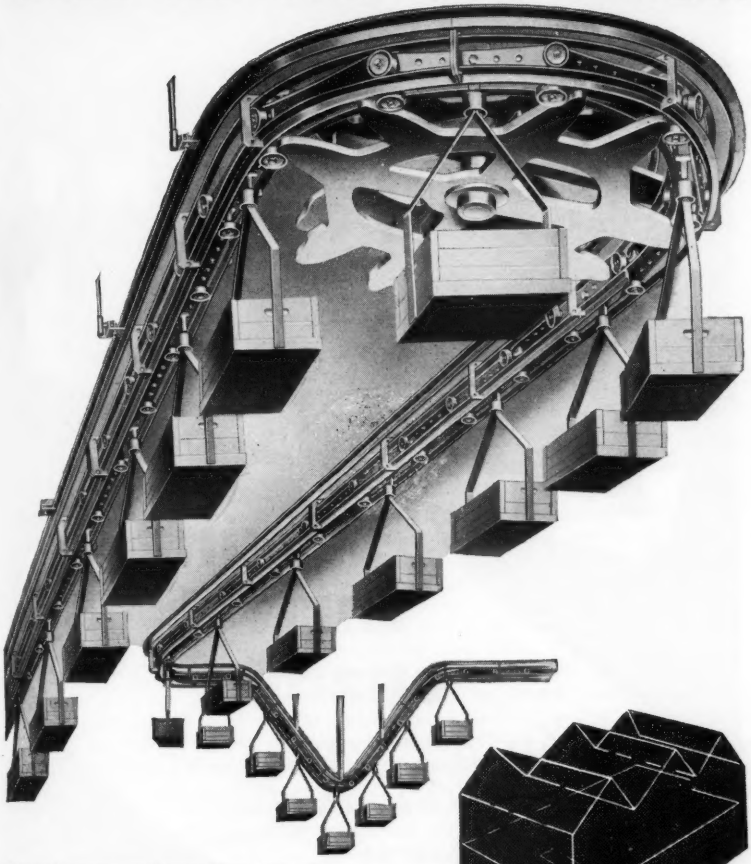

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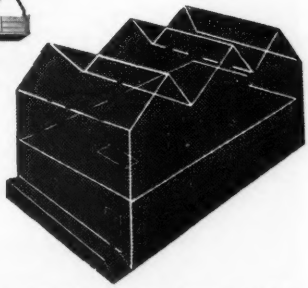

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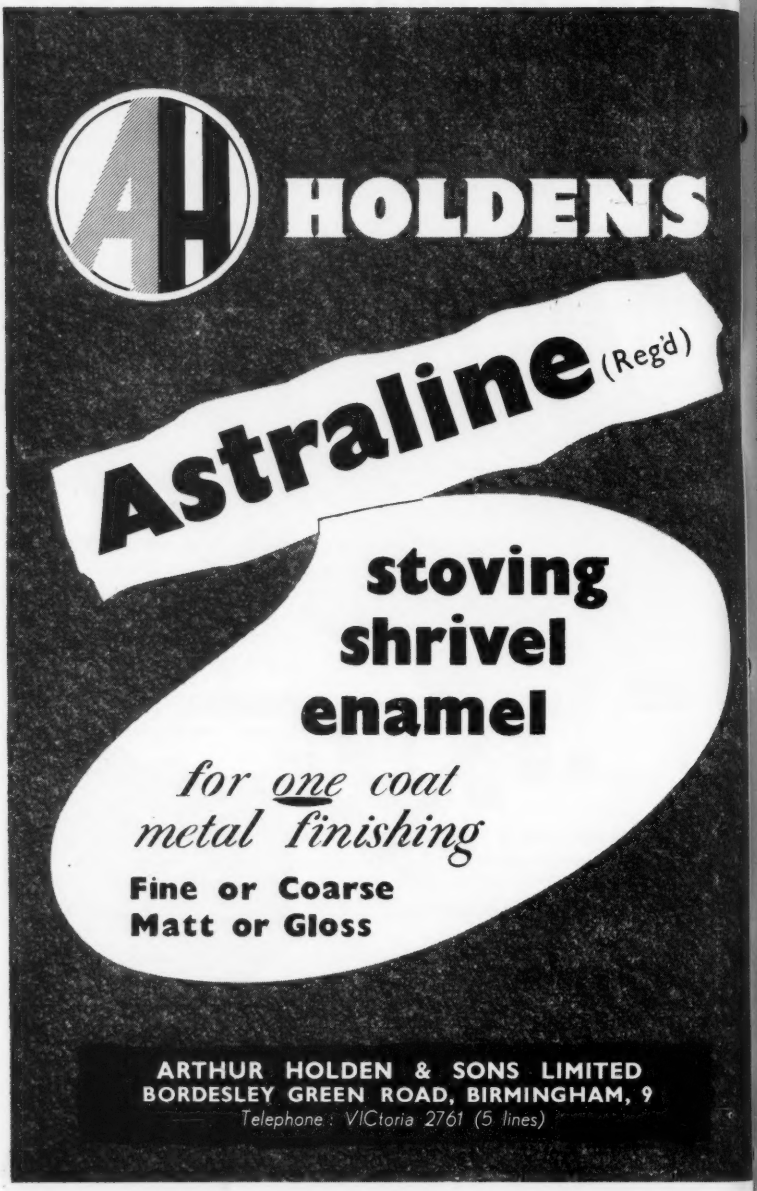
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An army that disappeared

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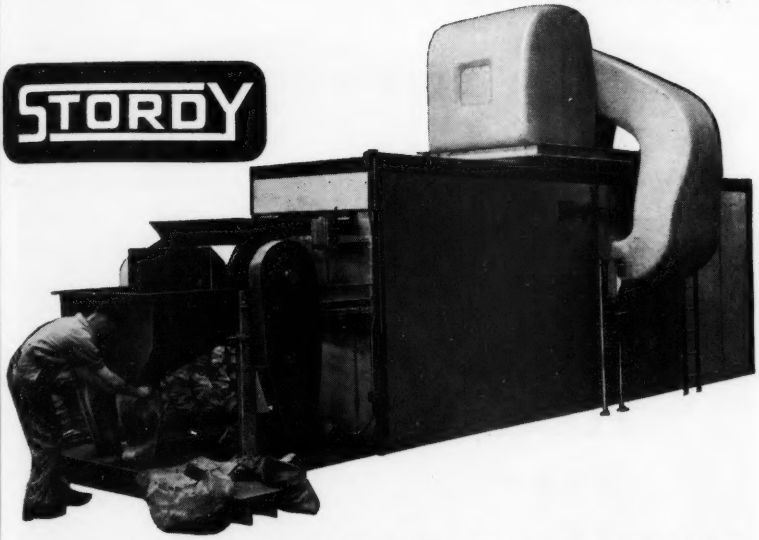
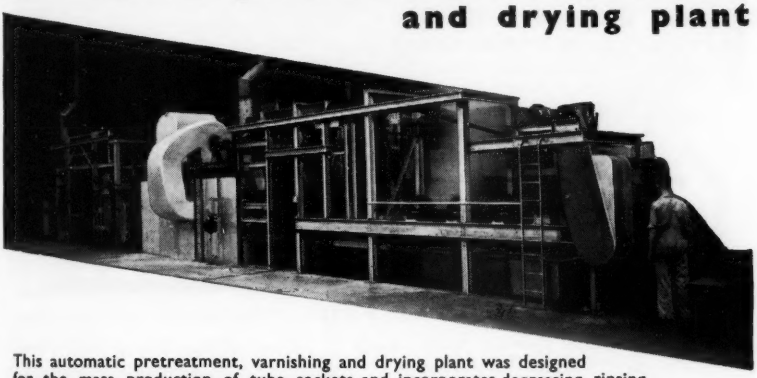


automatic, pretreatment, varnishing and drying plant



This automatic pretreatment, varnishing and drying plant was designed for the mass production of tube sockets and incorporates degreasing, rinsing, phosphate coating, dry-off, varnishing and final drying, in one continuous operation . . . . a completely automatic plant for the whole pretreatment and varnishing cycle.
The upper illustration shows the final drying section and the bagging chute; the lower illustration is from the loading end with the degreasing, rinsing and phosphate coating tanks in the foreground.
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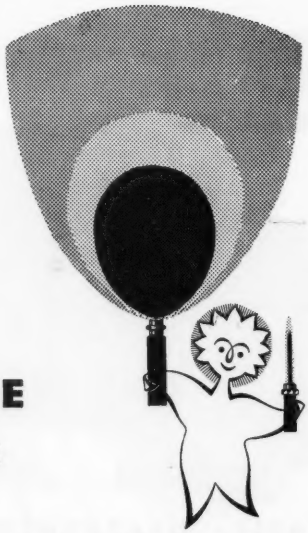

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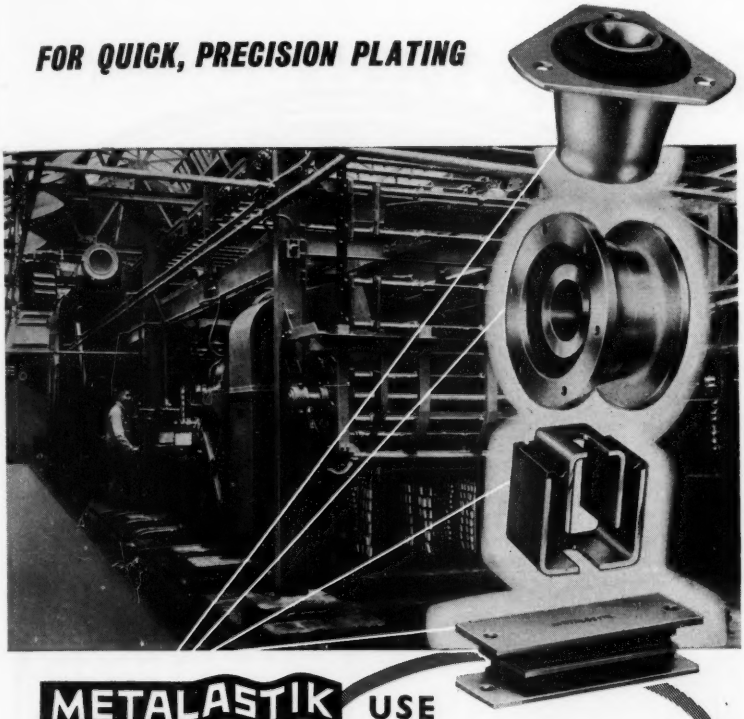

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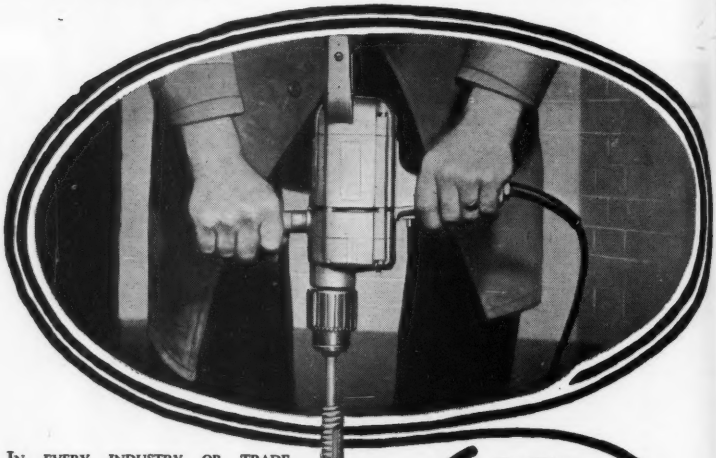

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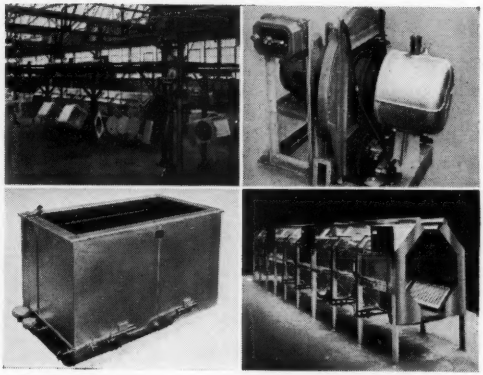

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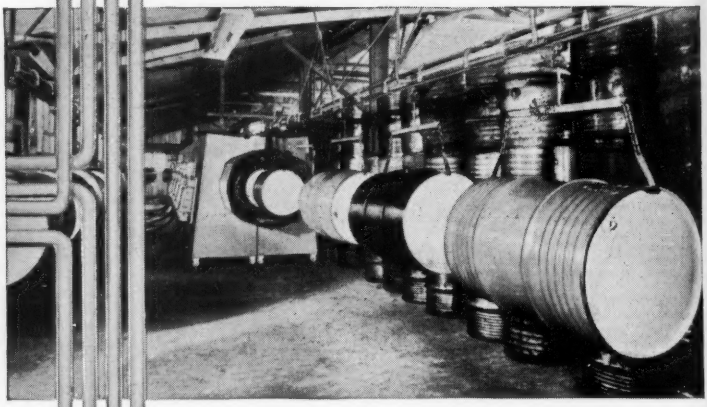

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she's been arrested!

What made her stop—look at—and buy that particular article? Quite simple, really! It had a more eye-taking finish than its brothers—it *looked* better, and other things being equal, was a more desirable purchase. That's the kind of sales compelling effect a Cellon finish can give to any product.

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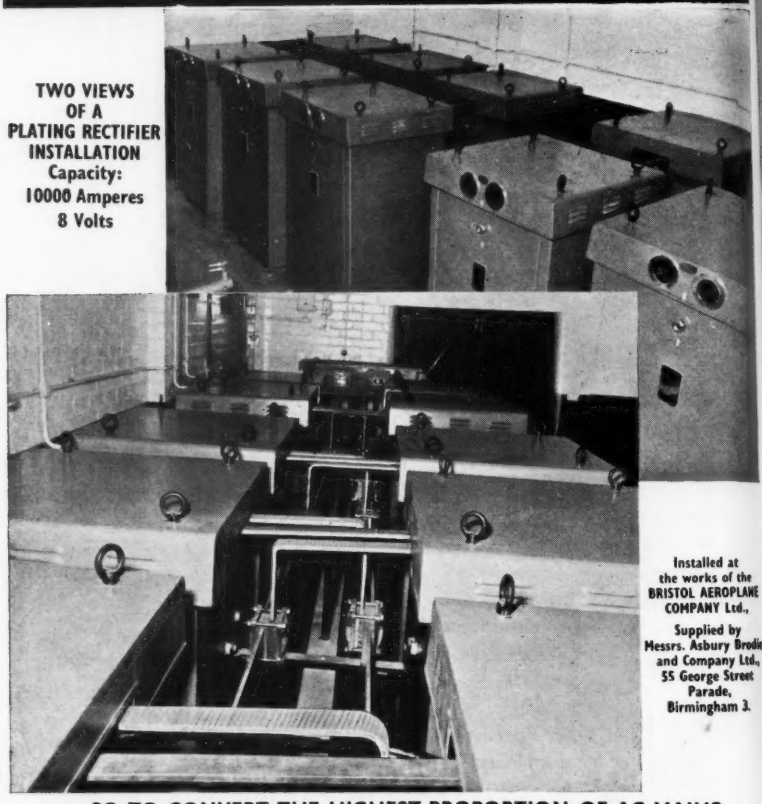

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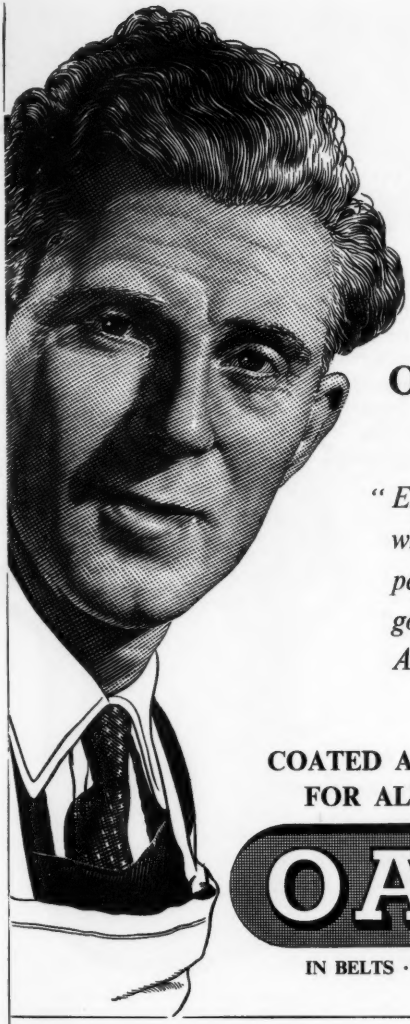

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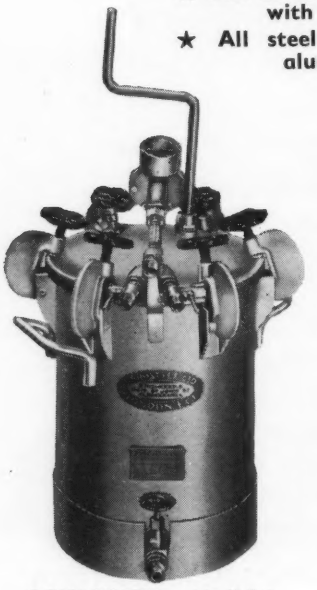

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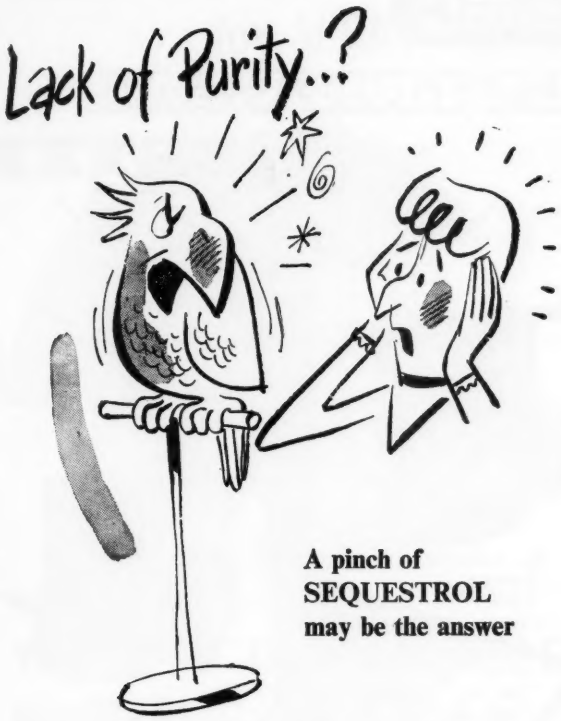

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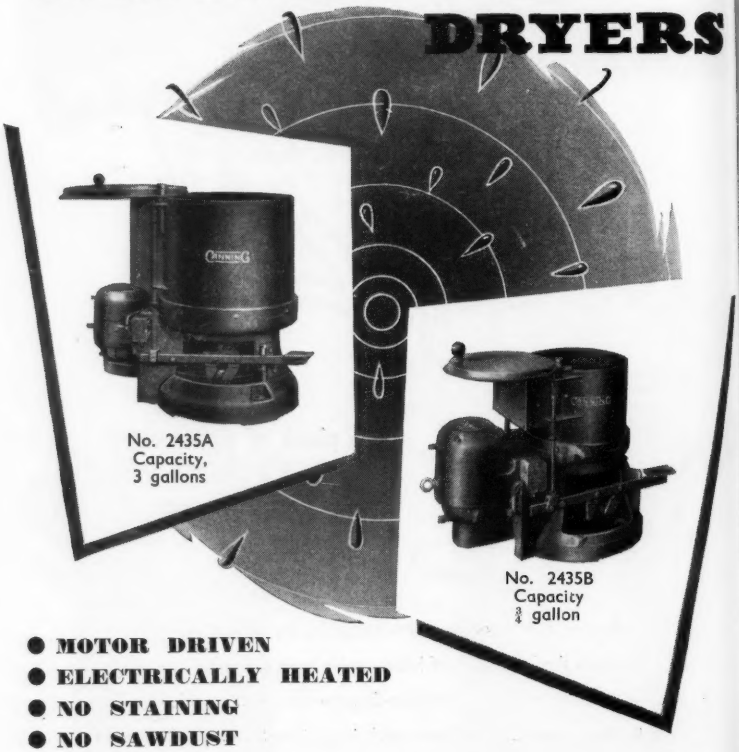

No. 2435A
Capacity,
3 gallons

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Capacity
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- NO SAWDUST

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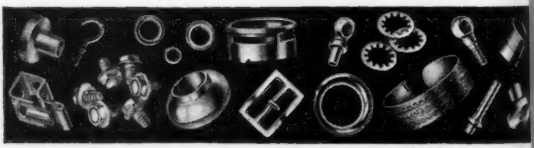

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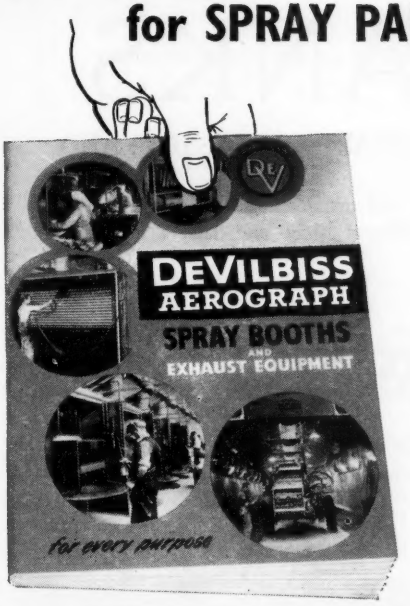

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describing the latest spray booth designs

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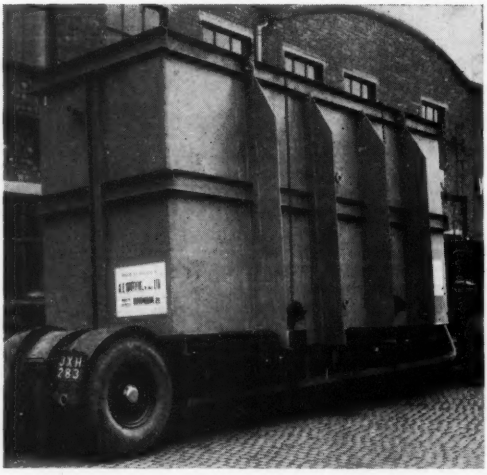

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SEPTEMBER 1954

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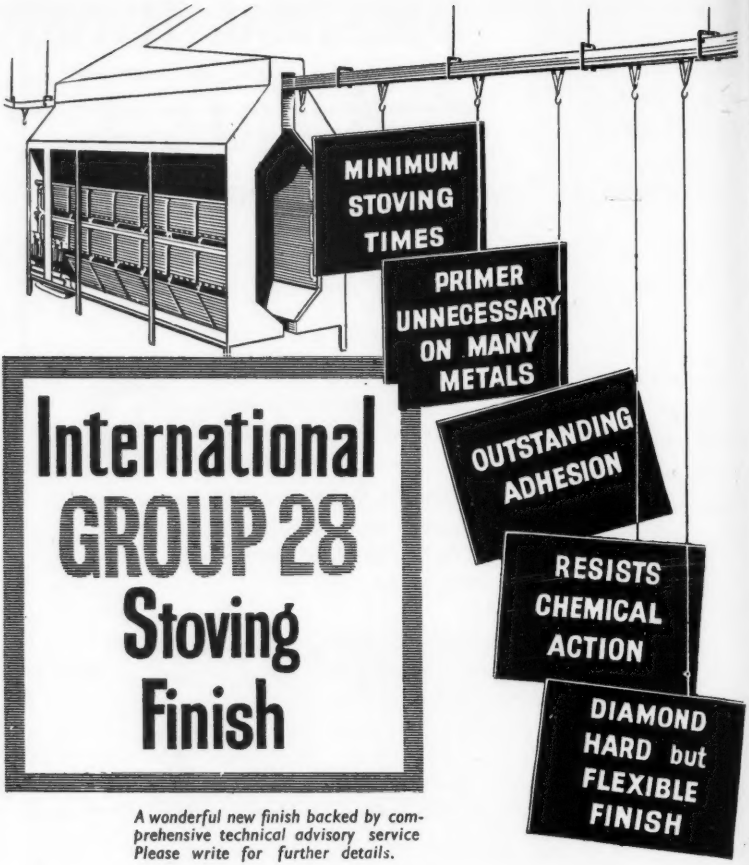

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Industrial Finishing

VOL. 7 SEPTEMBER, 1954 NO. 75

A Finishing Pioneer

SUBSEQUENT to World War I there grew up a tremendously important business which was a major contribution to metal finishing. This was the process of phosphating, whereby it was possible to coat steel with a rust inhibiting phosphate covering which served as an excellent key for subsequent painting. Undoubtedly one of the early pioneering companies in this field is associated with the name of Pyrene, and the Metal Finishing Division of the Pyrene Company largely grew up through the pioneering efforts of Mr. W. E. Wright, a present director.

It is true to say that Mr. Wright was one of the first men in this country to promote the full exploitation of phosphating on a commercial scale. The early "Parkerizing" and "Bonderizing" processes are well known, but development has proceeded and there are now some thirty phosphating processes in the Metal Finishing Division. Although Mr. Wright was promoting a Company with a proprietary process nevertheless there is no doubt that the overall contribution to rust prevention made by him, was immense.

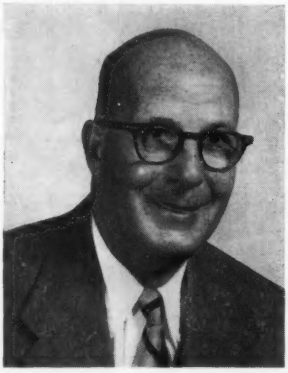
Because of his initial work in developing the use of phosphating coatings and initiating original research in the chemistry of surface reactions, Mr. Wright was elected to a Fellowship of the Chemical Society in 1944. He has just completed twenty-five years' service with his Company and as an expression of their esteem his colleagues in the Metal Finishing Division have presented him with a portrait of himself painted by Mr. S. J. Iredale. It was painted at Mr. Wright's home on the river bank at Staines and symbolises his keen interest in sailing. In the background there is a Moth Class yacht in which his young son, Howard Wright, has won many races.

There is no doubt that whilst Mr. Wright was leading his own Division with such vigour, he was simultaneously doing much to make British industry, and indeed the public in general, "rust conscious," and correspondingly aware of the necessity to reduce ultimate damage by corrosion. Today, practically every motor-car or motor-car component manufactured in this country is protected by some form of phosphate coating, and INDUSTRIAL FINISHING would like to take this opportunity of acknowledging the services given in the corrosion field by Mr. Wright.

Reducing Finishing Costs

by C. RAYMOND SYER*

MANY of us whom during the pre-war days, were employed by or contacted the various industrial plants where finishing room activities were being conducted either on a large or small scale, were aware of the fact that a substantial quantity of solvents and paint materials were being wasted.



Mr. C. Raymond Syer

In a large percentage of plants this condition was brought about through the lack of knowledge of the correct procedures of the various operations to control finishing room cost at a minimum, and in other plants it was directly due to allowing inefficient habit forming practices to continue indefinitely.

However, during the war period days when procurement of materials became vital, it was obviously necessary for many plants to curtail their daily paint consumption to a minimum, and this was accomplished by a certain percentage of waste in materials being eliminated.

Many articles of value on this subject were published in industrial magazines. These articles outlined important factors of interest to paint users as well as manufacturers, whereby substantial reduction in waste of materials would be obtained in adopting sound, efficient methods advocated in these articles.

During these days, I have noticed from observation and from actual findings in many plants which I have contacted and visited during my trip around the world, that the quantity of waste in paint materials existing today is practically equal to that of pre-war days.

If the dollar value of paint materials being unnecessarily wasted today throughout the world could be evaluated, plus the labour cost of finishing rejects, etc., and the loss of profit in sales to some manufacturers of their product due to lack of sales and eye appeal because of an undesired type of finished appearance, the figures would be astounding.

Rejects

Do More than Reduce Reject Numbers

How many times during the course of a year does the problem of rejects become the topic of discussion within the finishing room? Too many times, from the standpoint of efficiency. The "reject" has long been with us and will continue to be until the finishing and operating personnel alter their line of thinking to *preventing* rejected finished parts rather than *lowering* the figure. Too many times we take the easy way out by quoting reduced numbers of rejects, thus assuming the method of finishing to have reached

**Mr. Syer, a Metal Finishing Consultant in the United States, has recently completed a world tour during which he has studied and advised on finishing practice in many countries. This article on the vital subject of cost reduction reflects his wide experience.*

its peak performance. What of the remaining numbers?

Causes for rejected finished parts are numerous, indeed. However, this does not detract from their drain on operating costs as well as the time element involved and, last but far from least, the lack of a good finish on the product. At this particular time when new products and models are being planned and production changes contemplated, the opportunity to concentrate on eliminating rejects is readily afforded.

Utmost care in cleaning and preparing surfaces for organic materials, whether it be for roller coating, spraying, flow coating or automatic application operations, is, of course, essential. Likewise, the inspection and supervision of all finishing equipment is mandatory in eliminating rejects. However, there exist many other causes for rejects which might be classified as "unseen," efficient as a production line might be. The answer to problems of this nature can in many cases be found by constant adherence to controls.

Appearance of the Finishing Department

It is astonishing to notice that in a large percentage of the plants visited and serviced, very little attention is given to the appearance, and the necessity of maintaining good housekeeping habits in the finishing department.

This holds true to the large as well as the small industrial plants.

It is in this department where the final finish of the product is applied—the finish which has a definite reflection in eye and sales appeal. Where untidiness prevails, poor workmanship, which obviously effects sales and profits, is always apparent.

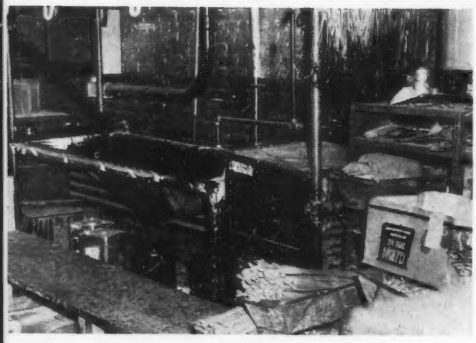
There is no factual excuse for a finishing department being unclean and disorderly if employees of this department are instructed, and trained in the correct procedure of cleanliness in the surroundings where they operate. It will be found that untidiness becomes a habit which can only be cured when steps are taken to teach each employee the necessity of good housekeeping habits.

Finishes contain flammable solvents. They present serious fire and explosion hazards which may endanger the buildings in which the paint department is located as well as adjacent structures and, possibly, the lives of the employees. For this reason, adequate safeguards and cleanliness should prevail. Adequate and reliable ventilation to prevent the accumulation of volatiles in explosive quantities is of prime importance.

It is imperative, if satisfactory results from equipment are to be obtained, that each piece of equipment be cleaned thoroughly at the end of each day. Where equipment such as lithographing press, roller coating machines, flow coating equipment, silk screen equipment, dip tanks, automatic spray painting machines, spray guns, spray hose, paint heaters, pressure tank, suction feed cups, air gauges, transformers, spray booths, ovens, metal cleaning equipment, etc., are not kept clean and in proper working condition; the percentage of rejects, the maintenance cost and replacement cost of parts or entire equipment, material and labour cost have been noticeably excessive. Production has been reduced by unnecessary delays, and a poor quality of the finished product has been apparent.

It would be well for management to consider having pictures taken of before and after a thorough house cleaning campaign, to compare the before and after effects. I have recommended this procedure in several plants. It has resulted in such a reduction in operating cost and improvement in appearance that management carried out the same idea in all departments, using the finishing department as an example of what could be accomplished in cleanliness throughout the plant. Tons of debris have been collected through this method and many materials which had become obsolete were salvaged.

There will undoubtedly be cases where it is believed that in order to maintain proper housekeeping, production will be retarded. This, however, is not true. The time spent in maintaining cleanliness will be more than offset by an increase in production, lower cost of finishing and satisfaction.



"It is astonishing to notice that in a large percentage of plants visited and serviced very little attention is given to the appearance, and the necessity of maintaining good housekeeping habits in the finishing department"

Good housekeeping will result in:

A. More uniform and desired finish.
B. Improved working conditions.
C. Increase in production.
D. Reduction in shutdown due to breakdown of equipment.
E. Reduction in percentage of rejects.
F. Reduction in paint consumption.
G. Reduction in maintenance and labour cost.
H. Reduction in equipment replacement cost.
I. Minimising of fire and safety hazards.
J. Increased eve and sales appeal of the product inducing customer satisfaction, and increased sales.

Photographs show the difference between good housekeeping and poor housekeeping. These are actual photographs. How does your finishing department line up in comparison?

Procedure to Evaluate Finishing of a Product.

1. *Requisites of Paint—*

PROTECTION—is directly proportional to dry film thickness, properly applied.

APPEARANCE—is directly proportional to dry film thickness, properly applied.

SANITATION—smooth, uniform film. Food containers, medical, household items.

REFLECTIVITY—dry film thickness, flow-out. Signs, lighting fixtures.

INSULATING OR CONDUCTIVITY—dry film thickness properly applied. Electric equipment.

2. *Establish Dry Film Thickness*—coating properties are influenced largely by film thickness. A definite pre-determined film thickness assures uniformity of quality and stabilises unit cost. Any excess in film thickness merely increases costs. The determining factor is actual dry film thickness and not number of coats.

3. *Getting the Right Paint*—determine performance characteristics desired. Have paint supplier formulate to insure those qualities. Make decided evaluation test for competitive purchasing. Smartest operations insist on two or more suppliers. Very important to use recommended solvent. Applied unit cost at given dry film thickness is the measuring stick, not price per gallon.

4. *Mixing and Reducing to Application Viscosity*—proper mixing or agitating will give dispersion of solids throughout the mix, uniformity of material, colour stability, etc. Incomplete agitating is often the cause of finish troubles such as streaky colour, poor adhesion, variable gloss, poor hiding, film and application characteristics. Generally a minimum of one half hour of thorough agitation is necessary to insure the proper mixing of pigments, solids, and solvents. Reducing to application viscosity should be done at one set temperature (preferably) 77°F. Thorough and complete stirring of the paint both before and after reducing is essential for good results.

5. *Material Handling*—dependent on production, paint volume and number of paints used. Wherever production is large enough a conveyorised line should be used. For supplying materials to operators a delivery of clean, fresh, uniformly mixed materials through pipe lines to spray guns makes for better working conditions. It eliminates the trucking of paint through the plant, prevents any mess around spray booths, makes possible a greater degree of plant cleanliness and reduces fire hazard: control of the delivery of the material to the spray gun operators cannot be passed over lightly, due to the cost of the material sprayed by each gun in the course of a day. For complete control of the delivery of material to the spray gun (where 30 gallon used in a day), the paint circulating system reduces paint handling costs and increases output.

6. *Method of Application*—manual spraying, automatic spraying-electrostatic #1 and #2, dip tank, automatic machines, roller coat, flow coat, silk screen, tumble, centrifugal.

7. *Provide Sufficient Flash-off Time*—natural evaporation of solvent before entry into curing ovens. If proper flash-off time is not allowed, blisters will occur in the paint finish, causing rejects and higher cost.

8. *Drying or Curing of Paint*—dependent on production, material, and space.

9. *End Result*—a product with eye and sales appeal, high stability and protection, at lowest possible unit cost.

Paint, solvent, application equipment and ovens can be acquired in competitive market.

Costs Can Be Reduced In—mixing, material handling and application techniques.

Among many of the items which are the cause of paint failures, waste of materials, excessive costs and fire hazards are the following:

1. Improper preparation of the surface to be finished.
2. Incorrect mixing and agitating of materials.
3. Incorrect viscosity.
4. Incorrect air pressures at spray gun and pressure tank.
5. Incorrect spray gun combination.
6. Faulty application technique.
7. Incorrect baking schedule (time and temperature, oven design).
8. Incorrect formulation of materials.
9. Inadequate methods in handling parts (poorly designed carriers and fixtures for suspending parts, group spraying).

10. Dirty and poorly maintained equipment.
11. Untidy housekeeping habits.

Paints are formulated to meet certain definite specifications for application, etc., and when these specifications are not adhered to, failures in the finish will certainly result.

To make a quality product it is necessary to set up standard operating procedures. Mistakes can be avoided by first arranging a plan of procedure, and then working the plan. Along with this plan each worker should understand clearly what he is to do and why.

An educational programme, including class room instructions, may need to be worked out, not only to inform workmen but to satisfy their natural desire to find out why certain processes are performed in the way specified. This procedure should be compiled with two basic ideas in mind namely: that a person cannot be taught, but can only be assisted in teaching himself; and that "QUALITY" must be built into a product; it cannot be inspected in.

Surface Preparation

As industrial operations become more precise and more demanding of mechanical efficiency and high quality, it is only natural that surface preparation should be viewed as critically as any other finishing operation.

It is a well established fact that a phosphate coating, produced by chemically treating the clean surfaces of formed sheet steel (and aluminium) parts, gives improved adhesion for any paint, enamel or lacquer coating that may be applied over it. This surface treatment also improves the resistance of any paint coating to weathering, salt-spray, humidity and moisture. A phosphate coating prevents the spread of corrosion from later breaks and scratches in the organic coating system. It also reduces the possibility of the paint blistering or peeling.

The failure of many finishes is caused more often to inadequate surface preparation before painting than by the use of any "poor quality finishing materials." The surface will be no better than the surface on which the finishing materials are applied, and the attention and care exercised in the pretreatment operations will definitely be reflected in the final result. Chemical cleanliness is essential and involves a considerable knowledge of metallurgy. Certain metals have such a high affinity for oxygen that oxides form almost as quickly as they are removed. These oxides may or may not be an obstacle to the finish. The metallurgical properties of the metal involved must be understood in order to determine if the oxide will be deleterious or advantageous to the coating.

In steel as in other metals, there exists a surface with pores which are usually filled with all types of soil. It is the removal of these soils that constitute a proper metal surface cleaning preparation. By soils is meant dirt, oil, grease, rolling residues, oxides, scales, etc. In other words, any material which is present on the surface of the metal and which is foreign to its natural condition is classed as soil. These, then, are the materials which are to be removed if we are to have satisfactory surface for the proper paint adhesion. The most common of these soils are predominantly rusting agents. By this is included alkali salts, moisture from sweating hands, chlorides, etc. It is not difficult to overlook these surface soils as they are not of necessity apparent to the naked eye. Initial paint films may be applied over these agents, without being aware of the potency and destructiveness of them. At the time of painting there would be no ill effects. However, after the paint film has thoroughly dried, cured or baked, moisture will penetrate through the pores of the paint film and cause activation of these rusting agents and surface oils.

When rust is formed and becomes hygroscopic it creates a vicious circle, forming more rust until the rust flakes from the lower strata taking with it the paint which was masking it. The removal of all resisting agents is therefore, most important for maximum paint adhesion.

Selection of Equipment; Call in Informed Men

In hundreds of industrial applications, experience has shown that the selection of equipment and its proper

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upkeep is too vital a subject to be casually dismissed.

Carelessly kept equipment results in loss of time, loss of production, poor quality workmanship and lack of interest on the part of employees.

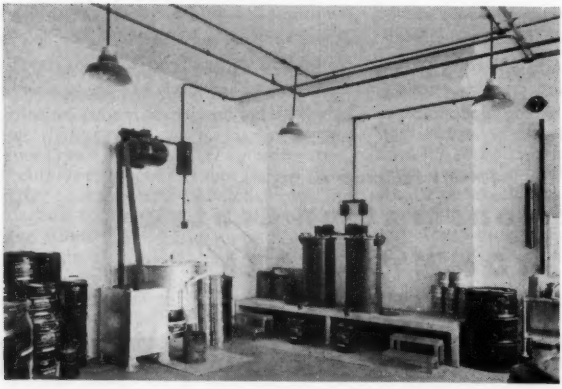
The cost of a machine for metal surface preparation will depend upon several factors, including the system to be used and its operating efficiency. Let us assume that we are going to use a 5-stage spray phosphatising machine. Now the satisfactory application of any phosphatising material is largely dependent upon the correct use of suitably designed equipment. This is needed to provide continuous trouble-free operation at a maximum efficiency.

Before deciding upon buying or installing any surface preparation facilities it is always best to call in representatives from both the chemical and equipment manufacturers for the purpose of discussing some of the major problems, for example:

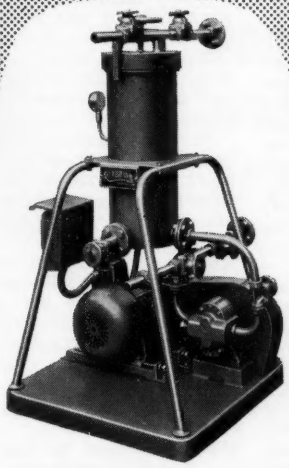
A. Process suggested or planned.
B. Exact sequence of operations.
C. Building layout.
D. Method of handling to tie in with other operations.
E. Production schedules.
F. Other important items.

By following such a procedure when plans are in the making, the best designed equipment and methods for processing can be selected to produce a quality job of phosphate coating. A 5-stage phosphating machine will take care of the combined cleaning and phosphating operations.

Regardless of what type or make of metal cleaning and phosphating



"Where untidiness prevails poor workmanship is always apparent": the reverse is equally true



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equipment is installed, an important addition will be an instruction manual or guide that gives detailed information on correct and economical operation and maintenance—something an average workman can quickly grasp and easily understand.

Set up and Maintain Process Controls

Real savings can be made by setting up process controls for the concentration of chemicals, together with maintenance instructions. Close control of the phosphating bath is necessary. Failure to check periodically the concentration of chemicals in the phosphating baths in your plant may actually result in the treatment doing more harm than good to your protective coating system.

In plants serviced, it has often been noticed that excessive quantities of chemicals were being wasted every day because those plants were not using controlled methods or procedure. Again in these plants, as well as in others I have serviced over the past years, I have seen phosphating equipment on which, apparently, very little time or engineering skill had been spent to design it for efficient operation. The design would not permit the user to get the desired quality of phosphate coating at a minimum cost of operation.

Features of the Cleaning Phosphating Machine

Some important features to consider when appraising the value of a machine for cleaning and phosphating metal products are: Spray zones should be separated by a sufficient distance to guard against excessive mixing of solutions by splash from sprays or from drain and carry-over. The time that parts are in drain spaces should be kept as low as practical. Splash guards should be provided at inlet and exit ends of each spray zone to reduce splash distance and air circulation through the equipment.

Drain space floors should be sloped in the proper direction for return of spray splash and drip, back into proper storage tank; and should be of heavy plate reinforced sufficiently to prevent buckling or unnecessary vibration. A suitable type of spray shield should be provided through the spray washing and processing units, including drain spaces between spray zones, to prevent "carry over" and keep the solution off the conveyor chain and trolleys.

Rinsing between the principal stages is really important. It reduces contamination of the operating baths, each of which is different chemically. Where spray zones are relatively long, the headers should be supplied near their centres and feed both ways, rather than end feeding.

Another important factor to consider is the proper positioning of risers and nozzles. Spray nozzles should be spaced to ensure continuous and complete spray coverage. Care should be exercised to stagger the spacing of nozzles in various spray risers so that actually the spacing in alternate risers is not greater than one-half the centre distances. Of course, we all understand the importance of keeping the risers and spray nozzles free of sludge and foreign substance to prevent clogging.

Where to Look to Get the Better Results, Less Waste

Any "carry-over" of materials from one stage to another will cause contamination which produces waste of chemicals because of the need for more frequent dumping of expensive chemicals, and the replenishment of chemicals to hold the solutions to the desired operating concentration. Frequent dumping, replenishment, and maintenance are a direct loss in operating costs, as well as in labour involved.

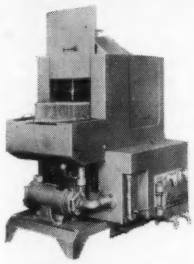
The mechanical features mentioned represent only a few of the major factors that should be given thorough consideration in order to keep operating costs down to a minimum, and to always get a good job of surface preparation.

Rejects; Evaluation Tests; Cost Data, etc.

Rejects are a great drain on profits. Without operating controls, rejects will appear. Water spots or stains are frequently noticed as the cause of rejects. The dry-off oven should be designed to provide plenty of heat and time for thorough drying all surface areas. The use of well designed equipment, and the complete control

Dawson Cleaning Plant

FOR DEGREASING & WASHING ALL TYPES OF METAL PARTS



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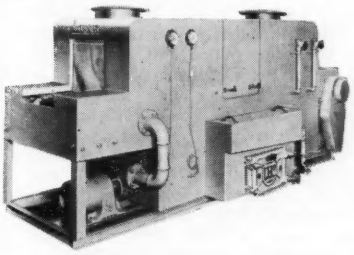
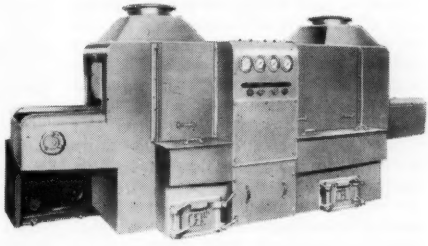
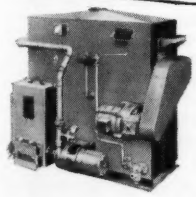
For washing only, having continuous output of large or small parts.

MODEL 'B'
For washing and rinsing medium size castings or baskets of small parts.

MODEL '00'
Rotary Drum for washing small parts of intricate nature.







The illustrations show four of the many types of Dawson machines built for the quick economical washing, rinsing and drying of Metal Parts of all sizes.

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of each and every operation will go a long way toward preventing rejects.

It is important that the phosphate coating thickness or "weight" be determined. The thickness or "weight" and other characteristics of a phosphate coating will depend upon the strength of the chemical solution and the length of time the metal in process is exposed to same. The required coating weight can be determined by making test panels and subjecting them to the required evaluation tests. A phosphate coating that is uneven or too light will not have the required protection or adhesion qualities. On the other hand a coat that is too heavy might be the cause of fracturing the paint surface in such areas where a roller coat finish is applied before drawing or fabricating are performed.

When the desired surface coating has been determined and controls are set up for the various operations, it is suggested that a daily record or weekly summary be tabulated to show the cost per thousand sq. ft. of coverage. This task can be accomplished by keeping record of the amount of chemical used plus the sq. ft. coverage. After several runs have been made a cost price can be obtained which can then be used as a standard cost. Using these cost figures, one can readily tell when costs get out of line. In plants where I have set up these procedures and controls, the annual savings derived have amounted to from $2,500.00 to $10,000.00 in chemical consumption alone. An equal saving has occurred in some plants from the reduction in cost of maintenance labour. Along with these savings, there might have been what might be called "intangible savings," such as increase in production, cuts in rejects, reduction in replacement parts, savings in heat, etc.

With controls carefully followed, the standard of quality improves. Uniformly high quality in any product will increase sales and assure more satisfied customers.

With intelligent use of proper controls, savings in your plant will increase in proportion to your production requirements. If you are not using a control system for operating and maintaining your phosphatising operations and equipment, I suggest that you consider the adoption of a carefully outlined system. You will be surprised at the savings possible, and the improvement in quality.

There are many plants, large as well as small, where the actual cost of finishing a product is unknown. In some of the plants I have serviced, and contacted I have been given an estimated cost, but when actual costs were determined they were found to be far in excess of what management expected. For example, in one large industrial plant an estimate cost of $0.35 was given, and when actual costs were tabulated it represented $1.75 per unit. While on the subject of actual cost, there are numerous plants where materials are being purchased only on the basis of the cost per gallon of the virgin material, instead of by the cost per sq. ft. of coverage, and many other factors which should be definitely determined if materials are to be purchased on a sound competitive basis. Consideration must be given to procuring a desired finish which will produce a QUALITY appearance as well as durability and which will stand the test required. Many times I stop and examine the finish on competitive products, and I am positive if management of these products could have examined the finished appearance of their product in many cases it never would have reached the store. Using only one source of supply is absolutely dangerous if consideration is to be given to purchasing quality materials at the lowest minimum cost, and competitive purchasing. It is always better to have the knowledge of more than one company. Too many times paint sales representatives or even paint technical representatives know only enough to be dangerous in the information they have on the quality and so on of the material they deal with. If trouble exists it is always better to contact the man who formulated the material. He will also get the inside information of how the material is being used and handled in the plant.

Numerous inefficient or incorrect procedures are still being used in a certain percentage of plants. Control of materials as received from the manufacturer, and as to be used does not exist. Control of correct air pressures to be used and correct viscosity

of materials for spraying operations have not been determined. A considerable amount of waste is apparent in plants where control of air and fluid pressures, viscosities and baking schedules have not been definitely established.

To ascertain the correct amount of air required at the Pressure Tank and Fluid Regulator, it is first necessary to have the proper adjustment of the spray gun, as explained herewith under "Spray Gun Adjustment."

(*a*) *Spreader Adjustment:*

The spray gun has built into it the ability to change the shape of the stream of finishing material from a small round pattern to a wide band. The varying of the pattern is accomplished by the selection of the setting of the spreader adjustment valve on the gun.

The spreader adjustment valve is the key to lower cost. The setting most suitable to the size and contour of the unit being painted should be selected. Spreader adjusment valve should be set at this setting and not changed at any time while spraying the same unit.

(*b*) *Fluid Adjustment Valve:*

The fluid adjustment valve which controls the flow of material through the spray gun should be kept open to first thread at all times when spraying from a pressure tank. The flow of material to the spray gun should be controlled at the fluid regulator and not by adjustment of this fluid valve.

Fluid and air pressures established should be used at all times. High pressures mean high costs. For example, using 60 lb. on the air and 6 lb. on fluid as a standard for a particular operation, costs rise as follows (cost figures based on a synthetic enamel at $3.00 to $3.75 per gallon, with spray gun opened wide for an hour):

60 lb. on air- 6 lb. on fl. $14.20 an hr.
90 lb. on air- 6 lb. on fl. $16.33 an hr.
90 lb. on air- 15 lb. on fl. $28.40 an hr.

The regulators are to be set so the fluid pressure is enough to obtain required film thickness without using extra strokes. Allow enough air on the gun to obtain good atomisation, but no more pressure beyond that point.

Air pressure should be checked constantly. The condition, length, and diameter of the air hose affects materially the pressure obtained at the gun. Check of pressures should be made at the gun, using a standard air gauge.

Many spray operators as well as finishing room foremen who allow incorrect air pressures to be used are under the false impression that by using high air pressures increased production can be secured through speed. This is an incorrect conception, and is one of the direct causes of high cost in paint consumption, rejects, and the waste of a considerable amount of paint material.

The following procedure is considered the only correct method to follow in setting up spraying pressures, both atomising and fluid, giving consideration to all known factors such as economy, production and quality, viscosity, type of paint, size and shape of articles to be painted.

Assuming that pressure-feed equipment is being used, and a modern spray gun, follow these steps in order.

1. Place object in booth, or hang it on a moving conveyor, (the conveyor being set to travel at regular production speed).
2. Set atomising air pressure at the air regulator between 45 lb. and 60 lb.
3. Give spray gun to spray operator with fluid adjustment wide open.
4. As operator starts to spray object, increase fluid pressure at pressure tank, paying no attention to pressure gauge, until operator informs you that he has sufficient paint for the speed required to do the work.
5. After being informed by the operator that he has sufficient paint, note the pressure on the pressure tank gauge.
6. Increase the pressure until the operator complains he has too much paint to do his work properly.
7. Note at what pressure the operator said he had too much material.
8. Reset the fluid pressure at a point half-way between where the operator said he had enough and where he said he had too much.
9. Returning to the atomisation pressure regulator, reset this at the lowest possible pressure to obtain

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This is one of the many drying problems which have been solved by De La Rue Gas-fired Process Panels.

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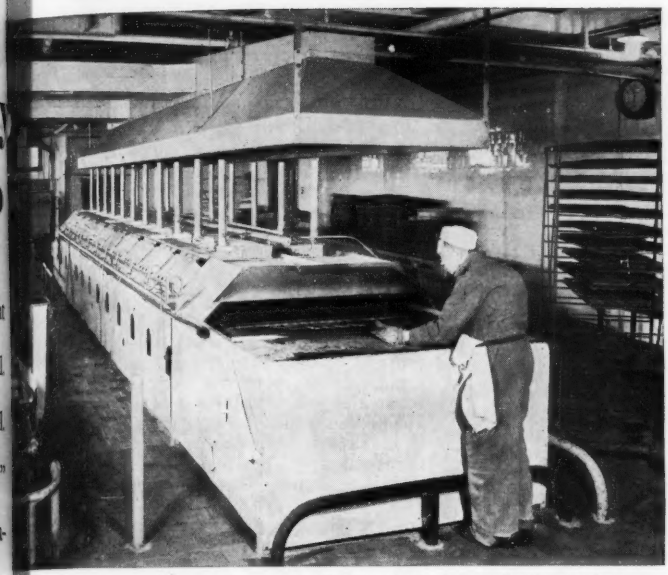

Photograph by courtesy of J. Lyons & Co. Ltd., Cadby Hall, London.

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the finish desired. First lower the pressure until the materials sprayed on the work are out of control. This will be indicated by runs, sags or beading. Next, increase from this lowest pressure until you have complete control of the material on the surface being sprayed.

10. Stop at the lowest pressure you are able to work with, and note the gauge pressure.
11. Insist that these pressures be used when spraying the type of materials used for setting up correct air pressures.
12. Instruct the spray operator that the spray gun fluid adjustment screw remain at the open position.

By using low atomisation pressures the daily consumption of paint materials will be apparent as a large percentage of materials will be saved which obviously are lost in the exhaust air when high air pressures are allowed to be used. There are many other factors where economy will be noticed when this practice is placed in order.

To all those interested in effecting savings it is suggested that a record of cost be tabulated over a one week period, using your regular spraying method. Then after establishing correct air pressure according to the twelve point procedure outlined here, keep the cost record for the same period of time. Comparison of the two cost records will definitely show that savings are available, in paint consumption, and lower maintenance cost for cleaning of equipment, spray booth and surroundings will exist.

Thorough Agitation of Paints Produces Best Results

Thorough agitating of materials should be accomplished both before and after thinning in order to get good results. Mechanical agitators of various types are available and should be used in place of hand stirring. Most pigments are heavier than the liquids and have a tendency to settle. If this takes place changes will occur in the viscosity and general proportions of the ingredients in the finishing liquid. Pigmented materials will not stay perfectly mixed indefinitely; they require agitating from time to time when in use. Proper agitating of materials will preserve its original uniformity.

Incomplete agitating of pigmented materials may result in one or more of the following:

1. The thin liquid material will be on top and the heavily pigmented material will be at the bottom of the tank or container.
2. Proper colour or sheen cannot be obtained. The finish will either be too flat or it will show too much gloss.
3. Highlights will appear, showing a poor texture in the final finish.
4. Heavily pigmented materials will not produce durable tough finish and this may cause a chalky film and not adhere well to the surface.
5. Thin materials will have poor hiding power and will contain an excess of oil and resin, which may cause "lifting" when dried film is coated with enamel.

Any of the results enumerated will obviously reflect against sales and eye appeal of the product. Reduced materials should be strained properly through cheesecloth or wire screen of such mesh or gauge as to remove all lumps, skins, etc.

(To be continued)

AN INVITATION

To individual readers: The Personal Reader Service Section facing page 144 is for your use and convenience, do you make use of it?

To firms interested in finishing shop supplies: You are invited to send in material suitable for inclusion in the above feature, there is no charge for this service and it is operated in our mutual interest.

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Finishing Aluminium Castings

ALUMINIUM is being put to ever increasing uses in industry today and as a result, greater attention is being paid to methods of finishing aluminium castings. Existing finishes are being improved and research constantly being carried out into new methods. The term "finish" is here regarded as treatment applied to aluminium castings in order to give decorative effects, or added protection and also to provide a surface having some special characteristic, such as high resistance to wear.

Recent developments as listed by A. P. Fenn[1] can be classified under the following headings:

1. Mechanical finishes.
2. Paint finishes.
3. Electroplated finishes.
4. Anodised finishes.
5. Vitreous enamel finishes.
6. Hard surfacing processes.

For some purposes the quality of the finish is largely dependent upon the quality of the casting, especially good condition of the surface and its freedom from porosity, and, to a less extent, alloy composition. It is important, therefore, that co-operation should exist between the founder and user at an early stage so that castings may be designed for finishing, when this is important.

The familiar processes of grinding, sand and shot-blasting, scratch-brushing, emery finish and barrelling are applied with the grades of material and speeds of operation appropriate to aluminium. The development of cold setting glues for application to emery mops enables closer control of glue-strength, and, therefore, of hardness, to be readily maintained. An air-flow mop of recent design, pleated so as to produce a current of air on the components as the mop rotates, keeps the work cooler and prevents unsightly burns from appearing on the polished surface.

Aluminium takes barrel-polishing particularly well and the method is used also for purposes such as burnishing, rough grinding, de-burring, flash removing, and breaking sharp edges. Abrasives, such as stones, wooden pegs, sawdust, or other carriers for the abrasive, together with water, soap solution, oils, etc., are used according to the type of finish required. Speed of rotation of the barrel, and period of barrelling, all affect the final result.

Although no new method of imparting a pleasant or striking finish by mechanical means has been developed recently, the existing range of treatments is wide and capable of diverse usage. To take only one example, the as-cast surface properly cleaned can be polished in selected areas to give a very effective contrasting finish of matt or reflective surfaces.

Paint Finishes

As with all metals, an aluminium surface must be free from grease and so prepared as to provide a good key for the subsequent priming coat. Aluminium alloy castings—sand castings in particular—sometimes provide the paint key without treatment other than degreasing. Of the mechanical pretreatments shot-blasting or grit-blasting are useful for certain limited applications while the chemical processes have long been established. A recent development, however, is an acid chromate dip which requires only short immersion times and allows considerable flexibility of operation. This process has been widely used in the pretreatment of castings prior to stove-enamelling. Examples of components pretreated in this way include window frames and fittings, wringer castings, motor-car fittings, optical and scientific instrument components.

Another development is a solution which can treat a mixture of metals, e.g., aluminium, brass and steel and is sometimes useful for pretreating assembled components by dipping.

The need for mechanical or chemical pretreatment of the surface can

sometimes be eliminated by the use of wash primers, sometimes termed etch primers.

These primers have a vinyl resin vehicle pigmented with zinc chromate, to which are added thinners containing phosphoric acid. The primer and the thinners are packed separately and when the two are mixed the solution has a usable life of four to eight hours. Some single-solution primers are now available which eliminate this limitation. A very good paint key is obtained as the phosphoric acid reacts at the metal surface to produce an effective bond. The mixture should preferably be sprayed on, but may be brushed on, and it should be allowed to dry out and harden before the application of further paint coatings. Exposure tests are beginning to show that wash primers should not normally be considered as a replacement for the conventional zinc chromate primers recommended for aluminium, when a fully protective system is required. Best protection is afforded by applying the zinc chromate primer as well as the initial wash primer.

The successful development of wash primers goes a long way towards solving the problem of pretreating large components too big for immersion processes. Still further developments in formulations of etch primers may be expected, and also of primers that incorporate substances with a high natural surface adhesion, not necessarily of a vinyl type.

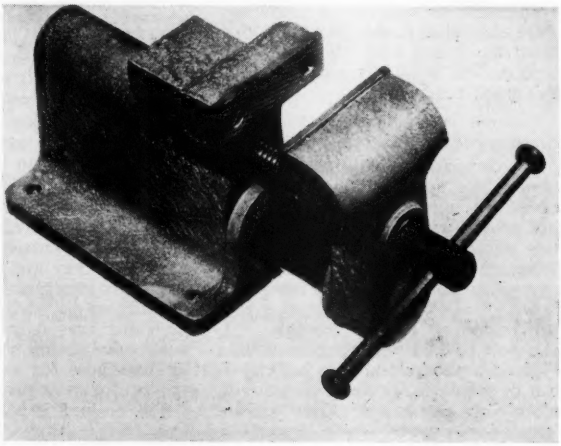
Either a one-, two- or three-coat paint system is applied for decoration and protection according to service requirements.

A single coat of clear lacquer may be applied to aluminium to preserve the brightness of a mechanical or chemical finish, the lacquer sometimes being stoved to give it greater hardness and durability. Lacquers used include natural and plasticised synthetic resins; cellulose enamel may be dyed. Air-drying, nitro-cellulose lacquer, modified with suitable resin, has proved satisfactory for small items used indoors; but occasionally two coats of this may be required.

Multi-coat systems are applied by the normal technique, beginning with a primer compatible both with the metal surface and the subsequent top coats.

Protective painting always requires two coats or more. There have been no striking recent developments in protective paint systems for castings, but the past few years have confirmed the merits of the paint systems consisting of zinc chromate primer followed by one or two finishing coats compatible with the primer. Amongst finishing coats should be mentioned leafing aluminium paint which has now reached a high standard of quality in the hands of reputable manufacturers. Aluminium paint of the non-leafing type is also used as undercoat.

Longer paint life on aluminium is



Light Alloy Bench Vice, die cast in alloy LM4 and finished in wrinkled blue enamel.

(Photo by courtesy of Griffin Metal Products Ltd.)

also to be expected than on other common metals such as steel, due to the more inert surface of the aluminium and the absence of corrosion creeping under the paint film.

Stoving enamels have progressed considerably with the introduction of new organic resins. Vinyl resins, epoxyethane, and styrenated alkyds are being used and give improved resistance to moisture and other common substances. They may assume an increased importance, particularly as some of them can be applied direct to aluminium without pretreatment. Thus, the application of two stoved enamel coats of a vinyl resin yields a finish that is remarkably water resistant, quite hard and suitable for many common purposes such as cast aluminium furniture, pedestals for small machines, fan bases, etc.

Another class of protective finish for acid resistance and chemical durability is a proprietary material based on synthetic resins, which may be sprayed on to a shot-blasted surface and stoved to yield a hard inert finish. Similar finishes are now also becoming available in a variety of shades useful not only for chemical plant but also for decorative work. Silicone paints possessing increased resistance to water and to heat have also been experimented with, but their relatively high cost and other difficulties have deterred their rapid development.

Bituminous paints have also been further developed and it is claimed that such paints may be pigmented with colour or with leafing aluminium flake that gives a durable finish, free from the strong tendency to bleeding through that is usually associated with this paint base.

Electroplated Finishes

By comparison with plating other metals, the deposition on aluminium of a satisfactory electroplated finish has proved a difficult problem, due to the stable oxide film on the metal. Research on plating methods has been more intense during the last few years, however, and this has resulted in improvement of plating processes. It can now be said with confidence, that —given a good aluminium casting—it can be satisfactorily electroplated with nickel or chromium. The zincate immersion process which imparts a zinc deposit to a properly prepared aluminium surface has been closely studied in the United States and England. This has led to the formulation of immersion baths of optimum properties, thereby establishing this method of pre-plating aluminium on a firm basis of research knowledge. Earlier processes such as the Krome-Alume process, which made use of a modified anodic film, have been superseded. In England a standard for pre-plating aluminium by the zinc immersion process has been issued and this is an indication that plating processes for aluminium are now being established and standardised.

The other process used with aluminium is based on a development of the Vogt process. This process has been in use for a number of years and, coupled with skill and experience has yielded plated products, particularly holloware, that have withstood many years' service.

One of the difficulties here is the tendency of unsatisfactory immersion deposits to be found on aluminium during the first few seconds in a plating solution—due to aluminium being among the more anodic of the metals involved. An important distinction between the two zincate processes is the use by Vogt of electric current to deposit the initial zinc layer.

Plating techniques require modification for the treatment of different aluminium casting alloys. Thus, the alloys containing appreciable quantities of silicon or of magnesium are less amenable to plating and success depends upon varying the plating conditions to suit the alloy. This is obviously a matter of experience with particular processes.

Alloys containing appreciable quantities of copper such as LM1, LM4, LM7 or LM11 can usually be electroplated more readily.

Both the above processes offer considerable promise now that they have reached an advanced stage of development and they are being successfully applied in electroplating shops. But it cannot be claimed that either is so perfected that it can be adapted to automatic plating plant which is the ultimate goal for any routine plating process for mass production.

The outlook is promising, however, and further study in the next few

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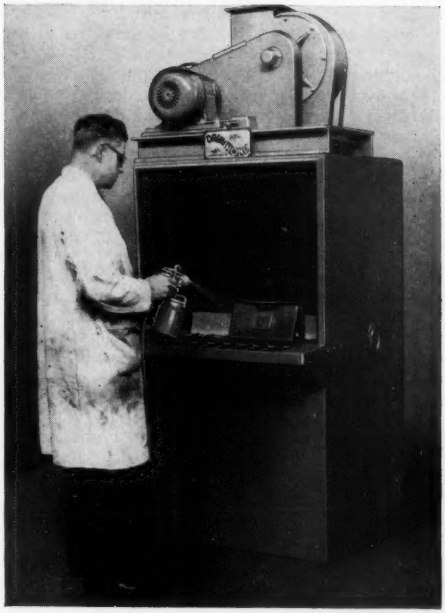

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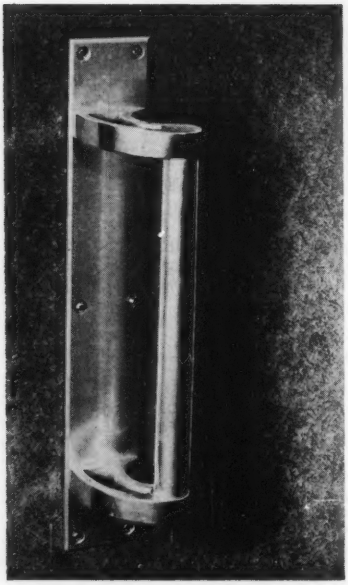
years is justified in order to bring electroplating of aluminium to a status and degree of reliability already associated with plating on other common metals. The claim (in U.S.A.) that bright nickel deposits can be obtained on aluminium pretreated by the zincate process is one indication that reliable and consistent plating techniques for aluminium are now emerging. Study is also needed of the performance in service of electroplated aluminium alloy components such as door furniture, car fittings, etc. Exposure tests necessary for obtaining such data are already being planned.

Anodising

By making an aluminium component the anode of a suitable electrolyte bath, the very thin natural oxide film is substantially thickened for decoration or protection. The electrolyte is usually sulphuric acid, the different type of film being produced by appropriate conditions of bath voltage and temperature, and period of immersion.



Door handle with uncoloured anodised finish

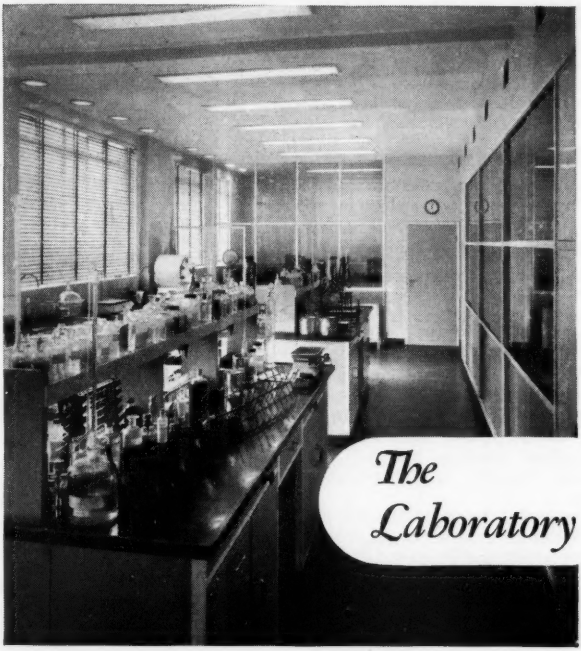
(Photo by courtesy of James Gibbons Ltd.)

A frequent complaint is that cast aluminium alloys, particularly pressure die-castings, cannot be satisfactorily anodised and dyed, and in consequence the process—at least for castings—has been rather neglected. But provided a proper foundry technique is adopted so that castings are produced with a good surface, free from porosity and flow lines, then the castings can be anodised to the satisfaction of the user. This is a case where co-operation between the founder and user is necessary at an early stage, since the design of the casting and the foundry technique will both be influenced by the need for successful anodising of the finished casting. This concerns mainly gravity die-castings and it must be admitted that the anodising of pressure die-castings is a more difficult matter. Even here, however, it is not entirely out of the question and by good foundry technique coupled with correct alloy choice and selection of a suitable finish (e.g., a mottled one) good results can be obtained.

Not all the alloys of aluminium are suitable for anodising. Thus, those containing substantial quantities of silicon invariably darken in the anodising vat and the finish obtained is not very pleasing, unless advantage is taken of the drawback to obtain a completely black finish. Alloys containing more than 5 per cent. silicon —and preferably less—should not, therefore, be considered for anodising. On the other hand, casting alloys of low or medium magnesium content—up to 5 per cent.—yield clear anodic films of pleasing colour and suitable for dyeing in pastel shades.

The development of alloys specially suited to anodising as well as to the particular casting process would be a fruitful field for exploration. Thus, in U.S.A., an alloy containing less than 4 per cent. magnesium and low zinc additions has been suggested for anodised die-castings.

Again, slight porosity in the casting creates pockets of acid electrolyte which, on subsequent drying, will attack the dyestuff and blemish the dyed surface. Barrelling before anodising greatly improves surfaces in this respect but must not be expected to change a porous casting into one suitable for anodising and dyeing.



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Electro-brightening

The production of highly reflective surfaces either for decoration or for functional use, may be by mechanical polishing, but there are also electrolytic processes which, followed by anodising, are highly successful. Bright chemical dips have also been developed. Costume jewellery made on the Continent has been brightened by such means.

Electro-polishing is also attracting attention, being one possible means of polishing a surface other than by hand, but it has not yet been applied very much to castings.

Vitreous Enamel Finishes

Although considerable research has been undertaken and much useful knowledge gained, vitreous enamel on aluminium is not yet a commercial proposition. Although expensive, it is used to a very limited extent in the U.S.A. for decorative signs and other architectural features and has also attracted attention as a fire-resistant coating.

The essential characteristics required of a vitreous enamel are hardness, abrasion resistance, impact resistance, resistance to atmospheric attack, moisture, hot and cold water, acids, alkalis, and foodstuffs. The surface finish of the enamel should be smooth and glossy and this gloss should persist for a considerable length of time. The enamel should be available in a variety of colours which do not fade. Further, the enamel should be non-toxic so that articles produced and finished by this method can be used in contact with all types of foodstuffs.

In addition to requirements for the finish itself, there are others dictated by the characteristics of the basis metal to which enamel is applied. Chief of these is a low firing temperature (of the order of 500° C. or less) as temperatures above this figure are likely to damage or distort the basis metal. The coefficient of thermal expansion of the enamel should be compatible with the metal itself and, therefore, about twice the value applicable to iron and steel. There must be good adhesion between the enamel and the basis metal, preferably obtained without any complex pretreatment of the metal surface or the use of special undercoats.

The two principal companies concerned[2] in the recent development work both found the problem of formulating and applying vitreous finishes with the necessary low melting point for application to aluminium, more difficult than had at first appeared.

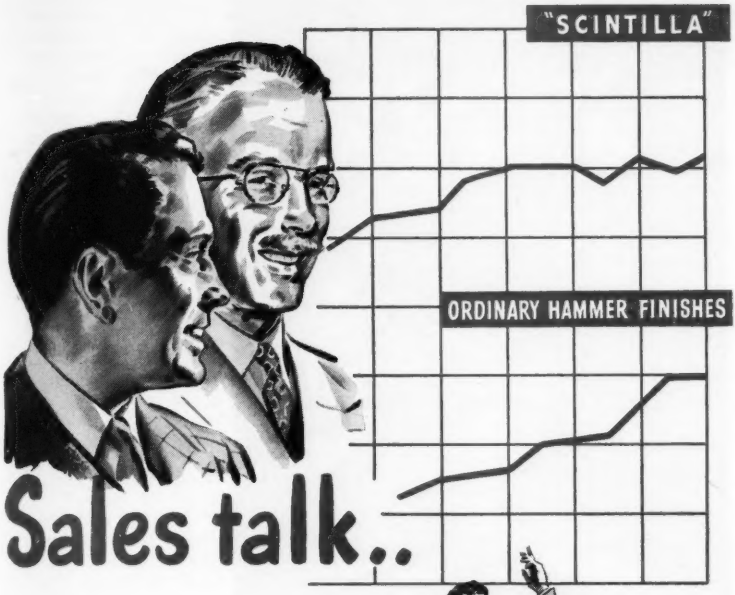
Additions of lead oxide to an enamel tend to reduce the melting point and the work of the duPont organisation in U.S.A., and of Fraser, Cianchi and Connor in England, was with the enamels containing considerable proportions of lead oxide and silica. Such enamels could be fired at temperatures of the order of 500° C. or even less, but the relatively low firing temperature was obtained only at the expense of reduced hardness, abrasion resistance, and resistance of the enamel to atmospheric conditions. One duPont formulation, however, has proved to be durable on prolonged exposure to the weather. Some difficulty in obtaining good adhesion was also encountered and special pretreatment baths containing alkaline chromates were found necessary, together with pre-firing of the component before spraying on the enamel frit.

Improved properties of the enamel were later obtained by Fraser, Cianchi and Connor, making use of the alkaline-earth group of oxides. These lead-free enamel compositions require a higher firing temperature, however, a minimum being 530° C. This temperature is considered too high for routine production as distortion of the casting would tend to occur.

There appears to be no other line of approach to the problem at present and it is even doubtful whether further research, even if intensely carried out for several years will yield results substantially in advance of those already obtained.

Hard Surfacing Processes

Increased attention is being devoted to chromium-plating aluminium to provide a hard surface resistant to wear and abrasion. A stage has now been reached where important engineering components can be treated in this way with expectation of consistent reliable coatings being produced. Direct plating processes are preferred such as those that make use of acid



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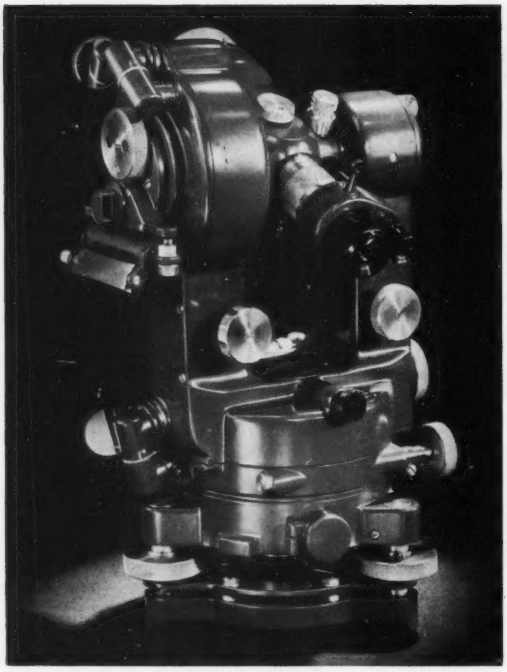

A finished die cast aluminium : microptic theodolite (No. 2)

(Photo by courtesy of Hilger and Watts Ltd.)

metal chlorides or organic acids. One novel process makes use of wet blasting, the quartz crystals being used retained on the wet surface during pretreatment so as to prevent oxidation. Here again, alloy composition is of some influence and casting alloys containing copper are preferred, although aluminium-silicon alloys have also been successfully treated. A process based on the direct application of chromium on aluminium is claimed to be suitable for most alloys, but those with magnesium contents of 7 per cent. and upwards are not favoured.

The thickness of chromium should not be less than 0·001 in. and for most applications it should be rather thicker. It has been stated that 0·001 in. thickness of chromium is sufficient to prevent pick-up on screw threads of such parts as petrol tank fillers; but thicknesses up to 0·002 in. have been used where very heavy loading and wear is expected. It is normal practice to plate slightly above the required thickness and to grind back to the actual dimensions required. As porosity in castings naturally leads to plating difficulties, gravity die-castings are preferred wherever possible.

A. P. Fenn visualises that the hard chrome-plating of cylinder bores, etc., will bring the all-aluminium automobile engine into the realms of the standard product of the future. In many of the modern German small cars air-cooled aluminium cylinder barrels with hard chromium-plated bores are a standard product, and motor-cycle cylinders are also regularly plated.

Recent developments in England and in the U.S.A. have perfected the production of anodic films up to 0·01 in. thick. The British treatment can be applied to alloys with either high copper or high silicon content, but it so far appears that the American "M.H.C. Process" cannot be used on aluminium alloys containing more than

5 per cent. copper, and some doubt exists as to whether 12 per cent. silicon alloy can be processed. The films in both cases are normally of slate grey colour but with variations in the alloy this may, on occasions, be slightly brown. Preliminary investigations indicate that this system of anodising produces an exceedingly hard surface film which has very high resistance to abrasion, the British process appearing to give the best results.

At this stage little more has been done in the development of the process than to study the characteristics of the hard films produced and to make a few service trials on possible applications. Undoubtedly the film is very hard and it is known that aluminium oxide in the form of ruby and corundum has a high intrinsic hardness. Micro-hardness tests and scratch hardness tests of these films give dubious values, however, often varying considerably according to composition of the aluminium alloy supporting the film. The readings are generally lower than would be expected. The film, which may be brittle, tends to craze when heated above 300° C. and often shows a crazed appearance as produced.

One successful application is the hard anodising of the channels in aluminium alloy castings used in a metal spraying pistol, the treated metal being very resistant to the abrasive action of air-borne metal powder.

In order to obtain more information on the properties of these thick anodic films a complete series of tests has been put in hand on both wrought and cast alloys. The tests to be made will include wear resistance, corrosion resistance, electrical breakdown, and thermal shock. If the results conform to the preliminary investigations many new applications for aluminium—and, therefore, finishing—can be envisaged, such as gears, pinions, turbine impeller blades, and many other items where previously aluminium could not be considered because its surface hardness was insufficient to withstand heavy abrasive action.

EXPLANATORY NOTES

1. Technical Development Engineer, Birmingham Aluminium Castings (1903) Co. Ltd., on whose paper this article is based.
2. E. I. duPont de Nemour and Co. (Inc.) U.S.A., and Amalgamated Research and Development Co. Ltd., U.K.

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Adherence of Porcelain Enamel to Steel

ONE of the first explanations advanced by scientists for the adherence of vitreous-base coats to steel was that of mechanical gripping. This hypothesis is based on the observation that when adherence is good, there is a rough interface between the coating and the metal, as shown in the sketch at Fig. 1. The coating penetrates into the cavities or undercuts in the metal surface and, when the coating hardens on cooling, the two materials are interlocked and thus mechanically bonded.

Recent Evaluation of Adherence

While previous investigators have noted that rough interfaces are associated with good adherence, there has been no quantitative study of this relationship, probably because a method of evaluating adherence quantitatively has only recently become available. This method was used by American investigators of the National Bureau of Standards,[1] who came to the following conclusions:

1. A positive correlation was found between the adherence of a porcelain-enamel ground coat and the roughness of the interface.

2. In general, adherence correlated better with anchor points per centimetre than with the increase in interfacial area (interface ratio).

3. The method of metal preparation has a marked effect on the relation between roughness of interface and adherence of porcelain-enamel ground coats to enamelling iron. In general, better adherence was associated with enamels applied to pickled iron than to sandblasted iron for the same degree of roughness of interface.

4. Most of the roughness that was associated with good adherence between a porcelain-enamel ground coat and iron developed during the firing process.

5. Roughness of interface is a necessary, but not a sufficient, condition for the development of good adherence between a porcelain-enamel ground coat and iron.

6. One or more factors other than roughness of interface also influence the adherence between a porcelain-enamel ground coat and iron.

Nature of Tests

To find these conclusions investigations have been conducted in which porcelain-enamel ground coats were prepared and applied under conditions that gave various degrees of adherence between enamel and a low-carbon steel (enamelling iron). The variations in adherence were produced by (*a*) varying the amount of cobalt-oxide addition in the frit; (*b*) varying the type of metallic-oxide addition in the frit, keeping the amount constant at 0·8 weight per cent.; (*c*) varying the surface treatment of the metal before application of the enamel, by pickling, sandblasting, and polishing; and (*d*) varying the time of firing of the enamel containing 0·8 per cent. of cobalt oxide.

Metallographic sections were made, on which the roughness of interface was evaluated by counting the number of anchor points (undercuts) per centimetre of specimen length and also by measuring the length of the interface and expressing results as the ratio of this length to the length of a straight line parallel to the over-all direction of the interface.

One basic frit composition and one mill-batch formula were used for all of the enamels prepared in this study. The frit composition is given in Table I and the mill batch in Table II. Each frit, with the appropriate metallic-oxide addition, was batched, smelted and prepared as an enamel slip according to standard procedures. Table III lists the metallic oxides added to the base frit batch to produce the various frits.

[1] *Richmond, J. C., Moore, D. G., Kirkpatrick, H. B., and Harrison, W. N., Nat. Advisory Committee for Aeronautics, Tech. Note* 2934.

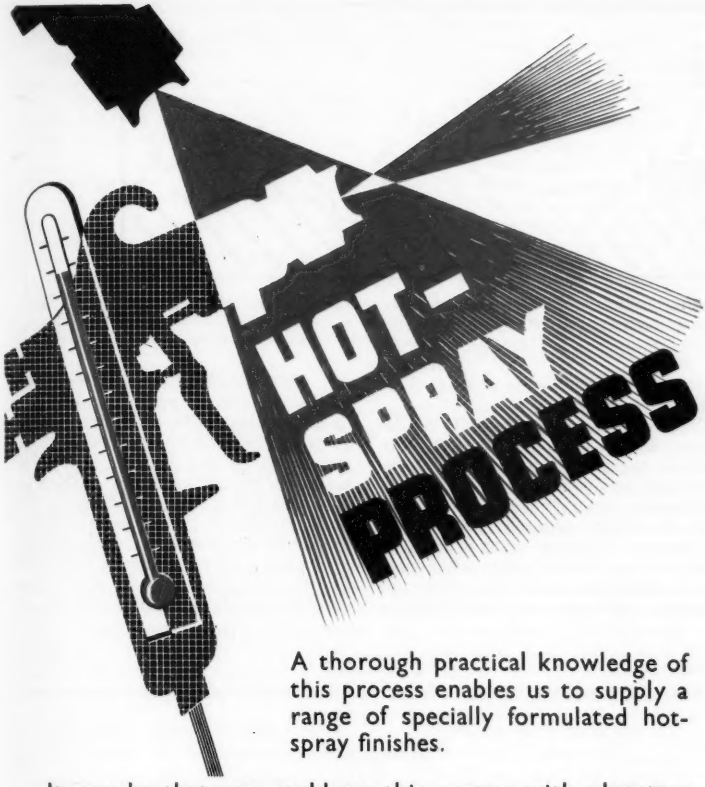

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Fig. 1. Sketch (x1,000) *of metallographic section of porcelain-enamel ground coat containing 0·8 per cent. cobalt oxide applied to sandblasted enamelling iron, showing rough interface between enamel and iron. This specimen had excellent adherence*

Choice of Oxides

The oxides indicated in Table III were chosen for several reasons. Cobalt, nickel and manganese oxides are commonly used as adherence-promotion oxides in commercial ground coats although manganese oxide is of no value when used alone and of questionable value when used in combination with the other two oxides. Antimony and molybdenum oxides are said to promote adherence to some extent. The other oxides were included because of the position of the metal in the electromotive-force series of the elements* in relation to iron and cobalt. In this series Cr^{+++} is above Fe^{++} (which is considered the active iron ion at the enamel-metal interface); Cd^{++} is between Fe^{++} and Co^{++}; and As^{+++} and Cu^{++} are considerably below Co^{++}.

TABLE I

BASIC COMPOSITION OF FRITS USED FOR PREPARING VARIOUS GROUND COATS

(*a*) *Batch Composition*

Material	*Parts by weight*
Potash feldspar	30·82
Borax (hydrated)	44·25
Flint	30·50
Soda Ash	9·16
Soda nitre	5·15
Fluorspar	8·30
	128·18

(*b*) *Computed oxide Composition*

Oxide	*Per cent. by weight*
SiO_2	51·0
B_2O_3	16·1
Al_2C_3	5·7
Na_2O	15·4
K_2O	3·5
CaF_2	8·3
	100·0

* *The electromotive force series of the elements was prepared from measurements of the potential developed between the element and an aqueous solution of the ion involved in which the ion was at unit activity (approximately one normal for most ions). Under these conditions the ions used in this study fall in the following order:* Mn^{++}, Cr^{+++}, Fe^{++}, Cd^{++}, Co^{++}, Ni^{++}, Mo^{+++}, Sb^{+++}, As^{+++}, *and* Cu^{++}. *It is known that molten glass acts as an electrolyte and that electrode potentials are developed in it, but the measurement of such potentials involves serious experimental difficulties. While the magnitude of the potentials may be considerably different, it is to be expected that the order of the elements will be about the same whether the electromotive force is developed in water or a glass, provided there are no complicating side reactions in the glass.*

TABLE II

Mill batch used for preparing ground-coat slips

(Milling time, 4·2 hr.; 50 ml. water plus three drops saturated $Na_4P_2O_7$ added before removing slip from mill; fineness, 4 gm. on 200 mesh from 50 ml. of slip)

Material	*Weight, gm.*
Frit	1,000
Enameller's clay	60
Borax	10
Water	425

Preparation and Application of Enamels

Twenty-gauge enamelling iron blanks, 4 in. by 4 in., were sheared to size and prepared for enamelling (*a*) by sandblasting; (*b*) by pickling, using standard procedures not including the nickel dip; and (*c*) by grinding and polishing.

The enamels were applied by dipping, and each slip was adjusted to give a fired enamel coating 5 ± 1 mil thick. Specimens of all enamels were fired at 1,575° F. for 4 min. except that a temperature of 1,550° F. was used in a part of the investigations where adherence was varied by changing firing time.

The adherence of specimens of each enamel prepared under each condition was evaluated in the test mentioned using seven specimens for each determination. The test evaluates the degree of adherence in terms of the amount of metal exposed by a standard deformation treatment, expressed as a percentage of the total deformed area. An adherence index of less than 50 by this test is usually considered so poor as to be commercially unacceptable. Although there is no standard classification of adherence indices, values of 50 to 75 were considered fair, 75 to 90 good, and 90 and above, excellent.

A metallographic section was made of each enamel having the adherence value nearest the average for the group, and evaluations of roughness of the interface were made on this section. For the first few specimens roughness was evaluated by examining the section microscopically and counting the number of anchor points per centimetre. Fig. 2 shows the criteria used in counting anchor points. These counts correlated well with adherence but the counting operation was very tedious since many fields had to be counted to obtain a statistically reliable mean value for each section.

TABLE III

Coating identification and metallic oxides added to base frit batch.

Coating Designation	*Oxide Added*	*Parts by Weight*[1]
I-1	—	—
A	Co_3O_4	·01
B	Co_3O_4	·1
C	Co_3O_4	·2
D	Co_3O_4	·4
E	Co_3O_4	·8
F	Co_3O_4	1·6
G	Co_3O_4	3·2
H	Co_3O_4	6·4
J	Sb_2O_3	·8
K	As_2O_3	·8
L	CdO	·8
M	Cr_2O_3	·8
N	CuO	·8
O	MnO_2	·8
P	MoO_3	·8
Q	NiO	·8

[1] *Added to quantity of raw batch required to make* 100 *parts of frit*

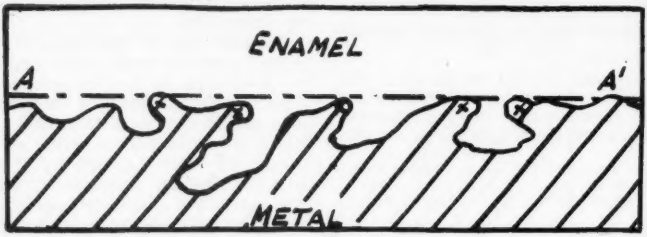

Fig. 2. Schematic section of enamel-metal interface, showing methods used to evaluate roughness. Anchor points (undercuts) indicated by x, were counted and expressed as number per centimetre of specimen. In the second method, length of line representing interface was measured with a map measure and expressed as a ratio of length of straight line A', parallel to interface

TABLE IV

Adherence, anchor points per centimetre, and interface ratio for coatings with various cobalt contents

Coating designation	*Cobalt content per cent.*	*Adherence Index*	*Error*[1]	*Anchor points no./cm.*	*Error*[1]	*Interface ratio*	*Error*[1]
			Applied to pickled metal				
I-1	0	5·68	3·25	63	43	1·11	0·020
A	·01	2·64	1·52	8	11	1·07	·012
B	·1	4·90	1·86	228	68	1·24	·032
C	·2	7·60	2·75	304	79	1·27	·032
D	·4	62·8	6·00	583	126	1·41	·060
E	·8	93·9	1·86	729	115	1·48	·071
F	1·6	91·6	2·09	898	134	1·59	·061
G	3·2	74·4	4·09	839	118	1·54	·061
H	6·4	65·3	2·89	1012	135	1·68	·074
			Applied to sandblasted metal				
I-1	0	1·80	1·06	173	49	1·25	0·033
A	·01	5·62	2·00	319	83	1·24	·047
B	·1	14·7	4·05	323	80	1·31	·059
C	·2	42·4	10·27	945	128	1·69	·095
D	·4	58·6	6·30	1028	126	1·62	·095
E	·8	90·7	2·67	1052	175	1·85	·132
F	1·6	84·8	4·06	1347	156	1·92	·139
G	3·2	84·3	2·52	1701	208	1·90	·091
H	6·4	77·6	2·91	1233	148	1·71	·105
			Applied to polished metal				
E	0·8	90·5	4·80	833	145	1·36	0·051
H	6·4	61·7	4·33	933	139	1·52	·064

[1]*95 per cent. confidence error for average value reported in preceding column*

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Photomicrographic Reproduction

In later experiments, photomicrographs at 1,000 diameters were taken of twenty areas selected on each section. The negatives of these photomicrographs were then projected on to a sheet of paper to produce a magnification of 10,000 diameter and a tracing was made with a soft pencil of the enamel-metal interface. Such a tracing is shown Fig. 2. Roughness was evaluated by counting the number of anchor points and converting this value to the number per centimetre length. An anchor point was taken as a definite undercut in the metal. An undercut overshadowed by another undercut was not counted. In Fig. 2 the locations to be counted as undercuts are indicated by crosses. Vertical lines, normal to the interface were used to determine whether or not a definite undercut occurred. As a second method of evaluating roughness the length of the line representing the interface was determined with a map measure. Results were expressed as the ratio of the interface length to the length of a straight line parallel to the interface (line AA' Fig. 2). This value was called the "interface ratio."

If adherence is due to the "keying-in" action of the rough interface, the best correlation between adherence and roughness of interface should be obtained when roughness is evaluated in terms of anchor points per centimetre. On the other hand, if adherence is due to a chemical bond between enamel and metal, the bond strength would be expected to be a function of area of contact, and better correlation should be obtained between adherence and roughness when roughness is evaluated in terms of the interface ratio.

TABLE V

Adherence index, anchor points per centimetre, and interface ratio for coatings containing 0·8 per cent. of various metallic oxides

Coating designation	*Metal-oxide addition*	*Adherence Index*	*Error*[1]	*Anchor points no./cm.*	*Error*[1]	*Interface ratio*	*Error*[1]
			Applied to pickled metal				
E	Co_3O_4	93·9	1·86	729	115	1·48	0·071
J	Sb_2O_3	62·5	8·27	603	117	1·43	·061
K	As_2O_3	3·33	1·14	91	50	1·13	·051
L	CdO	2·78	·76	87	63	1·14	·035
M	Cr_2O_3	·89	·32	16	19	1·07	·013
N	CuO	2·90	2·14	106	54	1·18	·039
O	MnO_2	1·80	1·50	35	31	1·08	·018
P	MoO_3	1·89	1·14	8	11	1·09	·012
Q	NiO	76·3	6·82	556	126	1·36	·053
			Applied to sandblasted metal				
E	Co_3O_4	90·7	2·67	729	115	1·48	0·071
J	Sb_2O_3	14·3	3·04	528	87	1·44	·070
K	As_2O_3	15·2	3·95	520	106	1·53	·100
L	CdO	18·6	2·48	394	79	1·46	·112
M	Cr_2O_3	7·9	1.61	567	124	1·48	·110
N	CuO	7·0	1·60	693	110	1·64	·119
O	MnO_2	4·2	3·95	378	87	1·40	·083
P	MoO_3	7·7	3·41	614	101	1·60	·111
Q	NiO	41·7	11·35	772	95	1·67	·100

[1]*95 per cent. confidence error for average value reported in preceding column*

TABLE VI

Adherence index, anchor points per centimetre, and interface ratio for enamel E (0·8 per cent. cobalt) fired various times at 1,550° F.

Firing time, min.	*Adherence Index*	*Error*[1]	*Anchor points, no./cm.*	*Error*[1]	*Interface ratio*	*Error*[1]
			Applied to pickled metal			
2	40·2	28·4	657	109	1·37	0·036
4	97·5	2·21	717	123	1·44	·051
6	96·9	2·28	740	110	1·50	·039
8	92·1	2·93	732	99	1·48	·040
12	88·3	3·50	744	106	1·46	·053
18	84·2	4·48	763	107	1·50	·047
			Applied to sandblasted metal			
2	48·7	11·2	787	122	1·61	0·091
4	91·1	3·0	1091	122	1·91	·105
6	91·3	3·2	886	135	1·66	·096
8	89·7	3·4	953	124	1·73	·082
12	85·3	4·6	847	131	1·67	·079
18	78·4	3·1	870	154	1·63	·090

[1]*95 per cent. confidence error for average value reported in preceding column*

Results

Preliminary data on the adherence, anchor points per centimetre, and interface ratio for enamels A to H can be plotted as a function of cobalt-oxide content. It will then be seen that the two measures of interfacial roughness correlate well with adherence.

The data on adherence, anchor points per centimetre, and interface ratio for the various specimens are presented in Tables IV, V, and VI.

Where adherence was taken as a function of the cobalt-oxide content of the enamel frit for enamels applied to polished, pickled, and sandblasted metal it was found that in each case, maximum adherence was obtained with enamel E (0·8 per cent. cobalt oxide). Type of metal preparation did not significantly affect the adherence of this metal but where the adherence was excellent (90 per cent. +) the enamels adhere better to pickled metal, and, where the adherence is poor, the enamels generally adhere best to sandblasted metal. Better adherence was obtained on pickled or sandblasted metal than on polished metal, especially for enamel H (6·4 per cent. cobalt oxide).

Where adherence was taken as a function of firing time it was found that adherence went through a maximum at some time between 4 min. and 6 min. Except for specimens fired for 2 min. (on which adherence was poor) better adherence was obtained in every case on pickled metal than on sandblasted metal. All specimens in this time test were coated with enamel E, found to give the maximum adherence.

In tests on enamels containing the various metallic oxides applied to both pickled and sandblasted iron, the effect of metal preparation was the same as before: if adherence is poor, the enamel adheres better to sandblasted iron; if adherence is good the enamel adheres better to pickled iron. No adequate explanation was found as to why the antimony bearing enamel adhered so much better to pickled iron than to sandblasted iron.

TABLE VII

Correlations between adherence and roughness of interface

Specimens			*Correlation Coefficients*	
			Adherence Against	
Variable	*Metal Preparation*	*No.*	*Anchor points/cm.*	*Interface ratio*
All	All	48	0·786	0·662
Cobalt content	Pickled	9	·904	·873
	Sandblasted	9	·926	·964
Metal oxide content	Pickled	9	·986	·961
	Sandblasted	9	·844	·816
Time of firing	Pickled	6	·806	·816
	Sandblasted	6	·663	·457

Adherence Factors

Correlation coefficients were computed for the relation between (i) adherence and anchor points per centimetre and (ii) adherence and interface ratio for each group of specimens, with the results indicated in Table VII. With but two exceptions, where the differences are slight, adherence correlated better with anchor points per centimetre than with interface ratio. This finding indicates that the keying-in action of the rough surface is probably more important than the effect of the increased area of contact between enamel and metal.

Two observations made indicate that one or more factors other than roughness of interface also affect adherence. These were that good adherence was in all cases associated with value of roughness above 500 anchor points per centimetre while values of roughness up to 1,000 anchor points per centimetre were sometimes associated with poor adherence.

Under optimum conditions no significant difference was found between the adherence obtained on polished metal, which was completely smooth before coating, and that obtained on sandblasted metal, which was initially fairly rough. This indicates that the roughness associated with good adherence must have been developed during the firing process.

NEW MEMBER OF AULT, WIBORG GROUP

AULT AND WIBORG LTD. have acquired the whole of the Issued Share Capital of General and Industrial Paints Ltd. (formerly Glasso Paint Products Ltd.), of Wadsworth Road, Perivale, Greenford, Middlesex.

General and Industrial Paints Ltd. are well-known manufacturers of high-class coating materials for a variety of industrial and general protective and decorative uses. They are prominent suppliers to the motor-car and transport vehicle industries.

General and Industrial Paints Ltd. will continue to operate under their own name and trade-marks as one of the Ault and Wiborg Group of Companies. The directors continue in office; no changes in the management and staff are contemplated. The chairman and managing director, Mr. F. Walter Burmann, has been invited to join the Board of Ault and Wiborg Ltd. and three directors of that Company will join the Board of the new subsidiary.

No issue of capital is contemplated by Ault and Wiborg Ltd., the purchase price being met out of current resources.

Reduction in Price of Shell Acetone.—The price of Shell Acetone has been reduced by £7 per ton ; the following price scale now operates:

In small lots.

5 gal. drums, £129; 10 gal. drums, £119 per ton.

In 40/45 gal. drums.

Less than 1 ton, £94; 1 to 10 tons, £91; 10 to 50 tons, £89; 50 tons and over, £88 per ton.

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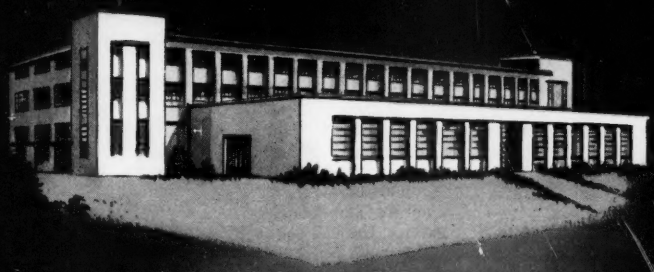

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Painting Aluminium Display Signs

FOUNDED as paint manufacturers in 1933, N. L. Cowling (Charlton) Ltd., of Woolwich Road, S.E., have, since the war, become perhaps the principal manufacturers of certain types of steel and aluminium advertisement signs in the country. With production at about 2,000 signs a day, they number amongst their clients many of the largest cigarette, tobacco, soft drink, tyre, petrol and oil companies.

The Cowling laboratory supervises the formulation and manufacture at these works of all paint used for the signs, and it is not unusual for over 800 colours to be developed annually —many covered by patent.

An important part of the day to day work in the laboratory is matching Cowling colours with those of their clients. Many advertisements, either in magazines or on signs, have become familiar to the public as much through colour as design, and clients are often anxious to keep to a well-established range.

Above: All these signs have been on this outside wall for over three years without signs of corrosion or paint failure. Below, left: Glazed signs about to be stoved

Two miniature triple rolling mills (each with a production capacity of 2 gal. per hour) are used for experimental work on the reduction of pigment particles—an essential stage in the production of new colours and in matching existing shades.

These act as pilot machines for the two full sized mills in the adjacent paint shed. The main feature of these mills are three solid steel rollers, set horizontally, each lightly touching the curved surface of its neighbour. The rollers rotate at different revolutions per minute, so that the paint passing over them is subject both to a crushing and an abrasive action at the point where the roller surfaces coincide. A further degree of pigment reduction is obtained in the refining mill.

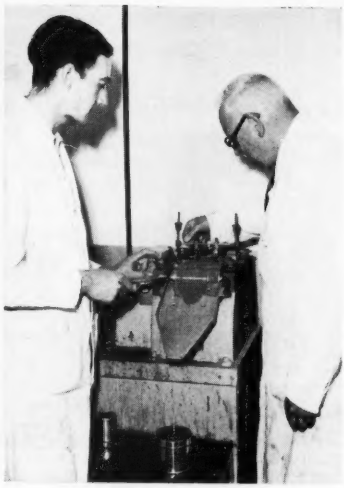
The manufacture of the signs, which are also designed at these works, is divided up into two phases: the production and painting of (a) steel and

(b) aluminium components. The steel, which is used mostly for the sign stands, wall brackets and other fixtures, is stored in the open on arrival at the factory, and invariably develops severe corrosion before being passed to the first production stage. The advertisement proper appears on aluminium sheet; while this metal, in tube form, is in many cases used also for framing the signs.

The first stage in production is the cutting, shaping, drilling and welding of both types of metal in a series of machine shops. There is also a separate shed for the more delicate work of bending and slot-sawing aluminium tubing.

From here the metalwork, already in component form, passes to the pre-treatment shed, where both steel and aluminium are degreased and the latter given a slight etch for paint adhesion. All steelwork is jenolized. There are two processing tanks, each with a capacity of 120 gal.: one is operated at a concentration of 1:2; the other, for a hot rinse after rust removal and proofing, is at 1:20.

For most work the painting systems have been standardised. All aluminium sheet receives one coat of zinc chromate primer, which has a rough finish and provides a good key for the rest of the painting system; one coat of background paint (that is, a synthetic enamel paint forming the background colour to the advertisement); one coat of printing colours (including lettering and trade-marks); and one coat of glaze.



The miniature triple rolling mill in the laboratory: Mr. N. L. Cowling, the founder of the firm is on the right

Silk screen printing colour applied to Regent advertisement

All steelwork receives a coat of zinc chromate primer or red oxide primer, depending on the particular component and the finishing requirements of the job; two coats of stove enamel; and one coat of glaze.

There are five stoving ovens. For stoving, priming and background paints, components enter the oven at 0° F. and remain until the temperature has risen to 250° F. Glazing coats receive the same treatment, with an additional half hour at 250° F.

As soon as each coat, including the glaze, has been sprayed onto the metal and stoved, every component is passed to the inspection department next door, where the work may be passed as up to standard; the paintwork touched up; or the job rejected as unsatisfactory. A remarkably high standard of work is demanded and achieved.

Finally the painted signs and various

The design department. In the foreground are two individual inn signs designed and painted in this department—a minor feature of of the firms work

components go to the last shed for assembly, packing and despatch.

Cowling signs are guaranteed for three years. There are the most rigid tests which serve to justify this guarantee. Laboratory examination includes ultra-violet ray tests which in 3½ hours can reproduce the wear and tear of three years outdoors. On the outer wall of one of the sheds are fixed signs of three or more years of age. The signs have, of course, become dirty: but there is no sign of either paint failure or corrosion of aluminium or steel—a tribute to the pretreatment and the carefully formulated and applied painting systems used on these signs.

SPACE-SAVING STOVING INSTALLATION

SPEED and the saving of valuable floor space are features of a recent paint stoving installation at the East Moulsecoomb Works of Allen West and Co. Ltd. Paint on castings and sheet metal components for electric motor control gear and switchgear is stoved in an electric infra-red heating plant which, being of comparatively light-weight construction, is mounted well above floor level, leaving the space below available for other production work.

An endless overhead cable conveyor, 116 ft. in length, is used to carry the parts through the paint spray booth where they are automatically rotated, and then, after a suitable flashoff period, into the infra-red plant. This plant, which is supported from the roof trusses, uses two vertical opposing banks of G.E.C. sheathed-wire element reflector units, each unit having two folded sheathed-wire elements mounted in a reflector trough of aluminium alloy. The plant has an over-all length of 18 ft., including vestibules at each end to minimise heat losses, and is wired in two sections each of which can be independently switched on and off. It is enclosed in a sheet metal casing.

The paint is stoved in approximately 2 min. and some 400 parts can be dealt with per hour. The infra-red plant, which has a maximum rating of 48 kW, was designed and supplied by The General Electric Co. Ltd.

ANALYSIS OF PAINTS, LACQUERS AND VARNISHES

THE Birmingham Paint, Varnish and Lacquer Club are holding a course of three lectures entitled "The Analysis of Paints, Lacquers and Varnishes" on the 2nd, 16th and 30th October, 1954. The lectures, which will be given in the large lecture theatre, Chemistry Department, University of Birmingham, are by N. W. Hanson of the Research Department, Imperial Chemical Industries Ltd., Paints Division, and will commence at 10 a.m. each day.

Applicants for enrolment should contact J. N. Hitchin, the Hon. Secretary of the Club, c/o W. Canning and Co. Ltd., Great Hampton Street, Birmingham 18.

American Finishing Developments

A DIGEST OF THE ARTICLES DEALING WITH FINISHING PROCESSES, WHICH HAVE BEEN PUBLISHED IN U.S.A. TECHNICAL JOURNALS.

A Simple, Efficient Manual Technique for Coating Deposited Carbon Resistors.—Protective coatings are applied manually to deposited carbon resistors at the Radell Corporation, San Juan, Puerto Rico. The operation is made efficient by the use of varnish dispensers equipped with motor stirrers, and tilted drying racks.

One protective coating employed for this purpose is a mica-filled melamine varnish. This is applied cold but is kept thoroughly stirred by means of a stirring fan on the shaft of a fractional horsepower motor. The dispensing container is completely covered—to prevent spattering as well as to minimise evaporation—with the exception of an opening only slightly larger than the resistor to be coated, located at the nozzle-shaped front end of the dispenser. The operator grasps the resistor by its leads with gloved hands, holds it in the opening of the dispenser, and rotates it until the entire resistor body is covered. It is then placed on a draining rack, mounted on an angle and designed in such a way that surplus coating flows down the rack rather than down the resistor lead.

After draining and drying in the air for about 1½ hours, resistors are transferred to a clean rack for baking 30 min. at 300° F. to set the material. When a synthetic resin enamel is used as the coating, the motor-driven stirrer is not required but the remainder of the technique is the same.

Racks must be changed between drying and baking because once the thermosetting material is baked onto a rack, it cannot be cleaned off with a solvent.

Liquid level is maintained at the opening of the dispenser by tipping the entire dispenser forward as the coating material is consumed. This is made possible by a mounting involving a shaft with locking wing nut.

Electronics, October, 1953.

Spiral Spring Conveyor for Coating Small Parts Eliminates Manual Handling, Reduces Production Costs.—If you coat or dip small parts as a part of your operations, you may be interested in a spiral spring conveyor system that reportedly eliminates manual handling and reduces production costs. Although the system is intended to be applied in coating and drying laminations, it is also suitable for acid cleaning baths, neutralisers, cleaning, painting, plating, baking and similar operations.

The main part of the system is a horizontal spiral conveyor, which is essentially a length of wire formed into a spiral like a coil spring (Figs. 1 and 2). If the spiral is placed over a support rod and rotated, it can continuously

KEY:

A. Guide rollers to prevent side sway.
B. Spiral conveyor.
C. Rubber pressure roller drives spiral.
D. Electric motor.
E. Support rod.
F. Pick-up arm.
G. Laminations.
H. Adhesive tank.

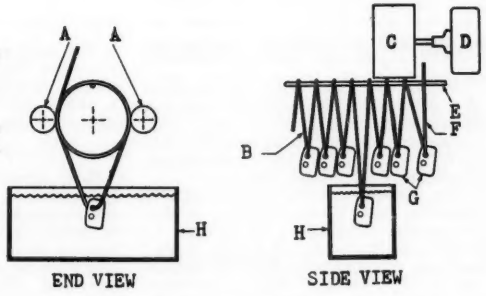


Fig. 1. Sketch shows how laminations can be carried by spiral spring conveyor. Parts without holes may be hung on hooks

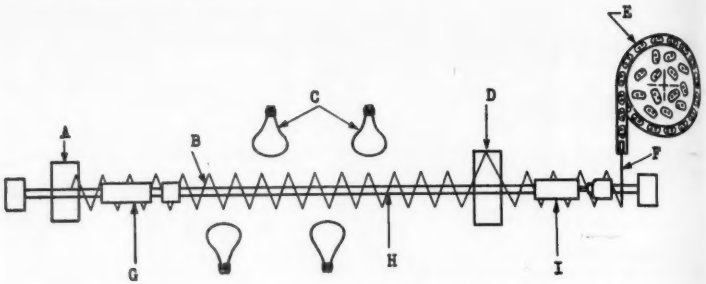


Fig. 2. System for complete production cycle of small parts. Many variations can be made

KEY:

A. Finished parts bin.
B. Spiral conveyor.
C. Infra-red drying lamps.
D. Adhesive tank.
E. Vertical-vibratory parts feeder.
F. Pick-up arm.
G. Pressure roller.
H. Support rod.
I. Pressure roller.

convey objects suspended from it. If all of the spirals are of the same diameter, the objects will travel in a horizontal direction. But if one of the spirals is larger in diameter, the object will dip down when it travels on the larger loop so that it can go into a container or tank. Several dipping operations can readily be incorporated into the equipment simply by constructing more spirals of larger diameter spaced at whatever intervals might be required. After dipping, objects can be conveyed past heating elements or on to further operations.

Drive for the spiral is provided by a pressure roller powered by an electric motor. If one roller is insufficient, additional ones can be positioned anywhere along the length of the spiral, except where it is a larger diameter.

Parts can be fed into the conveyor by a vertical vibratory feeder, and they are discharged automatically after travel.

A Typical Application

Small laminations required in the manufacture of an electromagnetic device are held together by an adhesive which is applied to the individual lamination and allowed to dry. Laminations are then assembled, placed on a fixture under pressure and cured by heat in an oven. Formerly an operator coated each lamination by placing it on a paper clip or hook and dipping it into a small container of adhesive. It was then placed on a peg board (nails driven into wood) to air dry from 10 to 15 minutes. An operator averaged approximately 2,760 laminations per day. By using the spiral spring conveyor, an operator is able to average approximately 11,520 laminations per day, at a small fraction of the former cost.

Flow, January, 1954.

CORROSION ADVICE BUREAU

THE British Iron and Steel Research Association has formed a Corrosion Advice Bureau in order to deal adequately with the numerous enquiries that are received for advice on the prevention of corrosion of ferrous metals.

The Bureau will be situated at 140 Battersea Park Road, London, S.W.11 (Telephone: Macaulay 5511). J. C. Hudson, D.Sc., D.I.C., A.R.C.S., F.I.M., has been appointed head of the Bureau and E. E. White, F.R.I.C., secretary. W. H. J. Vernon, O.B.E., D.Sc., Ph.D., D.I.C., F.R.I.C., F.I.M., has been engaged as consultant.

The services of the Bureau will normally be free to members of the Association, and also available to others on a fee-paying basis, depending on the extent of the investigations required.

T. C. Spray Finishing System.—At the Federation of Sussex Industries Exhibition being held in the Corn Exchange, Brighton (15th to 25th September) Water-washed spray booths are being shown in operation by T. C. Spray Finishing Systems Ltd. The same company are also demonstrating the Hot Spray Lacquer Process, and a Paint Tumbling Machine is on display.

Book Reviews

. . . and recent Technical Literature

INDUSTRIAL BOILERHOUSE EFFICIENCY

Chas. F. Wade

AN introductory chapter surveys the importance of boilerhouse efficiency and the main methods employed. The following chapters deal with the fuels available, the properties of heat, the process of combustion and the losses connected therewith, a description of the main types of furnaces, and various firing methods. The second half of the book includes chapters on instruments, feedwater, boiler types, heat insulation, auxiliaries and boiler settings, followed by the final chapters on fluctuating loads and thermal storage, boilerhouse records and management.

The book which therefore covers the subject fairly completely is written for the practical works engineer. It is easy to read, as all theoretical and mathematical items are either left out or are described in a simple way with the help of simple drawings. No doubt, it is based on practical experience over a very long period. It contains sound advice which will prove a great help for many engineers in charge of industrial steam boilers, especially of the Lancashire boiler type.

Crosby Lockwood and Son Ltd., London, 1954, 15*s*.

TITANIUM OXIDE IN VITREOUS ENAMELS

THE proper use of non-toxic titanium oxide produces enamels which combine in a thin coat the advantages of complete opacity, high brightness, acid resistance and good mechanical and thermal shock resistance. "Titanium Oxide in Vitreous Enamels," published by British Titan Products Co. Ltd., gives a wealth of information useful to both the frit maker and user.

The opening chapters of this 63-page book deal with the development, the grades and chemical properties, and manufacture of titanium oxides. Successive chapters give frit formulations for various purposes and information on black enamels for sheet iron and steel, acid resistant enamels and dry and wet process cast iron enamels. Specialised titanium enamels—aluminium, zinc titanate and borax substitute—are also dealt with; batch and calculated melted compositions are given throughout.

The appendix covers test methods for vitreous enamels, oxide compositions of enamel ingredients, expansion factors of enamelling oxides and enamel formulæ.

Obtainable from British Titan Products Co. Ltd., Coopergate, York.

NEW "ABC GOODS TRANSPORT GUIDE"

FOR the first time since denationalisation, traders in every type of business can now use free-enterprise long-distance road transport services. The names, addresses and telephone numbers of the people who operate them are contained in the recently published July-December *ABC Goods Transport Guide.* The edition also contains numerous entries covering hauliers who, while not operating regular time-table services are, nevertheless, in a position to carry any goods, anywhere, anytime.

Other sections of the guide give details of "smalls" or parcels services; names, addresses and telephone numbers of clearing houses; machinery carriers; bulk liquid carriers; British Road Services and railway offices; warehouse keepers; London public wharfingers; and air charter companies.

The guide, priced 3s. 6d., including postage, is published by Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

CHROMIUM PLATING

IN this book the four authors—Paul Morisset, director of the French Hard Chrome Information Centre, J. W.

Oswald, chief chemist, Fescol Ltd., C. R. Draper and R. Finner, editor and assistant editor, "Electroplating" — combine scholarship with wide practical experience of production chromium plating.

The book deals with hard chrome, decorative chromium—techniques, plant, properties and applications—ancillary processes, testing and inspection of deposits, control and analysis of solutions, health hazards, costing and waste disposal. It discusses significant developments up to the end of 1953. 584 pages, 222 figures, sixty-seven tables, price 78s. Robert Draper Ltd., 83/85 Udney Park Road, Teddington, Middlesex.

ENAMELLING FURNACE CONSTRUCTION AND FUEL ECONOMY

AN article entitled "Enamelling Furnace Construction and Fuel Economy" has recently been published by the Incandescent Heat Co. Ltd. Written by J. A. Swain, it was read as a paper before the Institute of Vitreous Enamellers, Northern Section. Mr. Swain examines the use of various types of furnaces, considering the value of Town's gas, producer gas, oil and electricity as fuels. Other chapters are on furnace construction and drying equipment. This 13-page booklet contains twenty-five illustrations; the fully descriptive captions give all the necessary technical data on the plant they illustrate. The preface contains a brief, but interesting history of the art of enamelling. Incandescent Heat Co. Ltd., Cornwall Road, Smethwick, Birmingham.

CLEANING AND PAINTING STEEL STRUCTURES

A CRITICAL abstract of the first five sets of "Specifications for Cleaning and Painting Steel Structures," issued by the Steel Structures Painting Council of Pittsburg, U.S.A., is available free of charge from the British Iron and Steel Research Association, Corrosion Section, 140, Battersea Park Road, London, S.W.11. Dr. J. C. Judson, Head of the B.I.S.R.A. Corrosion Section, originally prepared the abstract for the Corrosion and Electrodeposition Committee of the Inter-service Metallurgical Research Council.

The five sets comprise twenty-eight individual specifications, dealing respectively with surface preparation, pretreatment, paint, paint systems, and paint application.

Created within the last few years, the Steel Structures Painting Council of America aims to determine and outline the best methods of cleaning and painting steel structures, and, if possible, to issue a specification or code dealing with economical and practical means of surface preparation and painting steel structures. The Council, which consists of a score of large American organisations—such as the services, research establishments, railways and trade associations—also carries out research on structural steel corrosion as another of its functions, together with issuing and making available to specification and code writing committees' recommendations on the production of steel structures.

SHELL CHEMICAL SOLVENTS

SHELL Chemical Solvents, second edition, 1954, has been recently distributed. This 154-page book is divided into three parts; first a full description of each chemical solvent and a note of its chief uses, then a chapter "Application of Solvents in Surface Coatings," and lastly tables giving general data on solvents. Throughout the book is beautifully and clearly illustrated and tabulated.

A range of ketones and alcohols from olefines produced by thermal and catalytic cracking, is described, their production, properties and applications. Shell has pioneered the synthesis of these chemicals on an industrial scale.

In the section "Application of Solvents in Surface Coatings" much valuable information is given on nitrocellulose, cellulose acetate, cellulose acetate-butyrate, "Epikote" resins and vinyl resins. The uses, methods of application and solvent formulations are dealt with. Test methods for determining blush, dilution ratio, evaporation characteristics, flash-point, resin melting point, resin solubility and viscosity are described in a subsequent section. Altogether a most interesting, informative and well presented book. Shell Chemicals Ltd., Norman House, 105/109 Strand, W.C.2.

PAMMASTIC SHADES

TO illustrate some of the results of inter-mixing colours from the standard range of Pammastic, the plastic emulsion coating, a new showcard has just been produced by Blundell, Spence and Co. Ltd.

It shows sixty new shades obtainable by a simple 50-50 mixing. Included in these sample results is a comprehensive range of greys of varying depth, a new chocolate-like brown obtained by inter-

mixing Russet and Imperial Red, and a clover pink produced by mixing equal quantities of Porcelain Blue and Imperial Red.

"Since all shades of Pammastic are intermixable, this means a decorator stocking the complete range of twenty-three standard colours has, at hand, the means of producing any one of thousands of shades and tints in a plastic emulsion paint," declared M. K. H. Snaith, Home sales manager of Blundells.

"We are here merely suggesting sixty shades we consider of particular interest. By varying the quantities of one colour to another, or by mixing more than two standard colours, the range becomes so enormous as to be incalculable."

Blundells are one of the few firms manufacturing a plastic emulsion coating with deep shades included in their normal standard range.

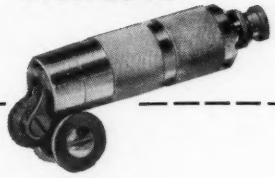
Fire Cements.—We have received from J. H. Sankey and Son Ltd. a new leaflet entitled "Sankey's Fire Cements." This gives full particulars of Pyruma and Aluma fire cements and Siluma hot patching cement. Pyruma fire cement is used in the construction and maintenance of fireclay and semi-silica linings. It withstands intense and intermittent heat up to approximately 1,580°C. Aluma plastic fire cement is used for bonding firebricks with an alumina content of 40 per cent. strength and upwards. It is used for setting, patching, pointing, rendering and washing. Withstands temperatures up to approximately 1,800°C. Siluma hot patching cement gives good results for the hot patching of fireclay, semi-silica and silica surfaces, and has high refractory properties. Copies of this leaflet may be obtained from the company at Refractories Works, Ilford, Essex.

Copper Development Association.—From the Copper Development Association, Kendals Hall, Radlett, Herts, we have received a copy of their Technical Survey covering, with critical comments, the technical progress in copper and copper alloys during the first half of 1954. Interested persons may obtain this 32 page booklet free of charge from the Association.

British Paints (Holdings) Ltd.—We have received a copy of the British Paints (Holdings) Ltd. pictorial survey of the activities of the organisation at home and abroad. There are sixteen pages of photographs of factories and departments in them, together with a list of the organisation's factories throughout the world.

Contact us

—if you have a problem concerning decoration



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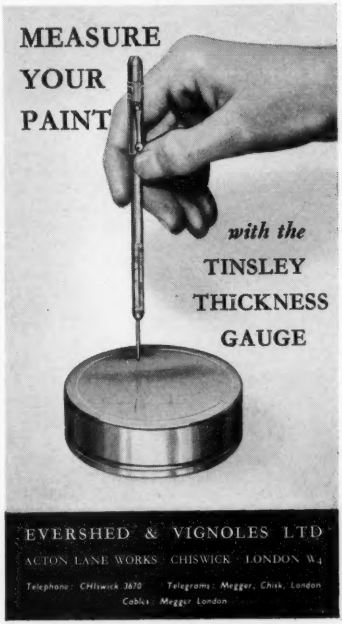

NAMES IN THE NEWS

INTERNATIONAL PAINTS NEW OFFICE

—Mr. C. W. Hunter in Charge

INTERNATIONAL PAINTS LTD., have announced the opening of a new office in the centre of Birmingham at 177 Corporation Street, Birmingham 4, and the appointment of Mr. C. W. Hunter, late of British Resin Products Ltd., as area manager.

This office, working in conjunction with the company's depot at Amington on the outskirts of Birmingham, has been created to improve service for decorative and industrial customers in the West Midlands.

Mr. Hunter has a team of representatives under his directions, and a considerable sales drive is planned. In the near future a technical representative will be attached to this branch for the handling on the spot of technical queries, specifications and investigation of any paint difficulties.

Mr. J. S. Morton.—Mr. J. S. Morton, D.F.C., has been appointed a director of Electro-Chemical Engineering Co. Ltd.

Change of Address.—The new address of Alexander Lewis & Co. (Paints) Ltd. is "Alco" Works, 127-133 Ormside Street, London, S.E.15. (Telephone: New Cross 2498.).

Change of Telephone Number.—Hess Products Ltd., manufacturers of "Distec" products, have changed the telephone number of their head sales office, at 4 Albion Street, Leeds, to Leeds 301945.

MR. E. C. VORLANDER

THE appointment of Mr. Edward C. Vorlander as managing director of Honeywell-Brown Ltd., British subsidiary of Minneapolis-Honeywell Regulator Company, is announced by Paul B. Wishart, president of the parent firm.

Honeywell-Brown Ltd., is Honeywell's largest manufacturing and sales division outside North America.

Mr. Vorlander, whose headquarters will be in London, has been with the company for twenty-two years, serving in various administrative capacities. Most recently he has been administrative assistant to Mr. Tom McDonald, executive vice-president, with headquarters in Minneapolis.

V. D. MacLachlan continues as director and general manager of Honeywell-Brown Ltd.

Mr. E. C. Vorlander

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General Metal Finishing Processors to Industry.

Protective, Durable and Decorative.

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READER SERVICE SECTION

Items in the following list of manufacturers' literature are available as a personal service to readers of INDUSTRIAL FINISHING *by using the reply card below.*

In addition, the editorial staff of INDUSTRIAL FINISHING *are always available as an advisory service on questions affecting finishing.*

Metal-Bonding Adhesives. A booklet gives technical data and full description of the properties and applications of synthetic resin adhesives primarily designed for bonding metals, but widely useful for other materials. Adhesives described are both hot and cold setting. Aero Research Ltd., Duxford, Cambridge. (109)

Beryllium Nickel. A pamphlet contains information on the development of beryllium nickel, its applications and available forms and a description of its use in casting parts. Tables give details of the properties of beryllium nickel castings and compare it with other casting alloys. British Unicorn Ltd., 36-38 Southampton Street, London, W.C.2. (110)

Bakelite, Vybak and Warerite Plastics. A 16-page, illustrated booklet describes Vybak plastics, Bakelite resins and moulding materials and laminates, and Warerite plastics, their applications and properties. The vinyl resins with good ageing and adhesive properties can be supplied for incorporation in paints, the Bakelite resins are supplied in both hot and cold setting suitable for most veneering and constructional processes; grades also exist for bonding metals, etc. Bakelite Ltd., 12-18 Grosvenor Gardens, London, S.W.1. (111)

Mica in Aluminium Paints. Technical notes explain the applications of mica in aluminium paints both as a simple extender to reduce costs and also to confer special properties—corrosion resistance, reducing yellowing, etc. Micafine Ltd., Raynesway, Derby. (112)

Air Conditioning Unit. Coloured, illustrated leaflet gives information on a self-contained, quiet air-conditioning unit

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INDUSTRIAL FINISHING

157 HAGDEN LANE, WATFORD, HERTS.

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NOTICE: Students and other than United Kingdom subscribers should request literature directly from manufacturers.

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Name _____ **Position** _____

Firm _____

Address _____

READER SERVICE

incorporating sealed compressors. Very close temperature control is claimed for applications where such control is necessary. Rated flow is 400 c.f.m. Dimensions are 41½ in. high by 39⅞ in. wide by 21⅛ in. deep. The Fuel Efficiency Co. Ltd., 20 Upper Ground, London, S.E.1. (113)

Spray Gun. A coloured brochure gives details of an internal atomising spray gun designed to handle oil paints, cellulose and synthetics, distempers and the new range of plastic emulsion paints. Amongst special features are an internal mix cap producing a round spray pattern, a 45° angle fan spreader and a pressure relief valve. Operating pressures are from 20 lb. to a maximum of 40 lb. per sq. in. B. E. N. Patents Ltd., High Wycombe, Bucks. (114)

Electrostatic Flocking and De-tearing. Illustrated brochures give details of a range of flock depositing machines and spray guns, adhesives and flocks with information on the methods of application and scope of use. An electrostatic de-tearing process for dip coated articles is also shown. Spraytex Ltd., 168/172 Oxford Road, Manchester 13. (115)

Adding/Listing Machine. A portable adding/listing machine is described in illustrated pamphlets. Its features are addition, direct subtraction, item repeat and automatic four-line spacing after totals and sub-totals. Dimensions 12½ in. by 7 in., weight about 12 lb. Block and Anderson Ltd., 58-60 Kensington Church Street, London, W.8. (116)

Fire Cements. Coloured leaflet gives details of fire and hot patching cements. One, suitable for fireclay and semi-silica linings in furnaces, etc., withstands heat up to 1,580° C., another for bonding all firebricks with an alumina content of over 40 per cent. withstands temperatures of up to 1,800° C. J. H. Sankey and Son Ltd., Refractories Works, Ilford, Essex. (117)

Conveyors, Stackers, etc. A number of coloured, illustrated brochures give information on conveyors, electric hydraulic and manual hydraulic stackers, trucks and loading conveyors. J. Collis and Sons Ltd., Regent Square, Gray's Inn Road, London, W.C.1. (118)

Adhesive Tape. Transotape "bonded" for extra tenacity can be used for sealing, identifying, protecting and as an anti-pilfer safeguard; has many general applications. Can be printed to requirements. Folder gives full details of uses, how applied, etc. John Gosheron and Co. Ltd., Gayford Road, London, W.12. (119)

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157 Hagden Lane,

Watford,

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INSTITUTE OF METAL FINISHING

The Institute of Metal Finishing Thirtieth Session Opening Meetings of Branches will take place as follows:

London Branch. The 20th September, at the Northampton Polytechnic, St. John Street, London, E.C.1, commencing at 6.15 p.m. "Surface Finishes by Vacuum Evaporation" by F. C. Weil, Ph.D.

Sheffield & North-East Branch. The 24th September, at the Grand Hotel (Fitzwilliam Room), Sheffield, commencing at 6.30 p.m. Subject "Barrel Polishing."

Scottish Branch. The 6th October, at the Institution of Engineers and Shipbuilders in Scotland. 39 Elmbank Crescent, Glasgow, commencing at 7 p.m. Chairman's Address and "This Electroplating" by S. A. J. Murray.

Organic Finishing Group.—The first meeting of the Group for the new session will be held in London on the 28th September, at the British Institute of Management, 8 Hill Street, London, W.1, commencing at 6.30 p.m., when "Precision in Spray Painting" by J. Muirhead will be presented. The paper will be followed by a film entitled: "Making the most of the Spray Painting Method."

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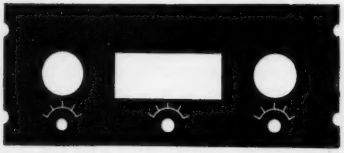

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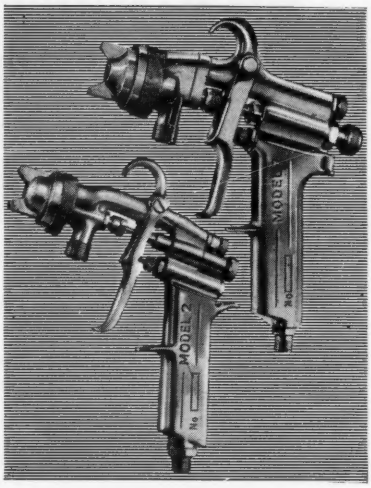

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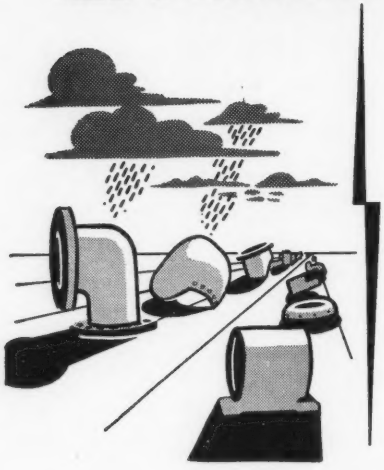

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Amongst a number of special lecture courses also arranged are: "Corrosion and Packaging," a series of five lectures by specialists to be held on Monday evenings commencing the 27th September and "Recent Developments in Metal Finishing," a short series of lectures to be held on Mondays commencing the 15th November.

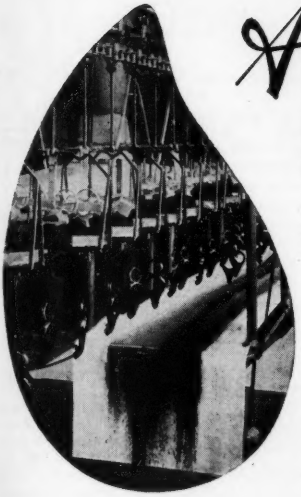
A two year course in *Corrosion Science* has been arranged as a preparation for the Institute of Metallurgists' examination in Corrosion and Surface Treatment.

Enrolment dates are from 20th to 22nd September, and the new session begins on the 27th September.

1955 CITY & GUILDS EXAMINATIONS

THE dates and times of the 1955 City and Guilds of London Institute examinations are:

Technology of Pigments, Paints, Varnishes and Lacquers: Operatives' Course, written, Tuesday, 3rd May, 6.30 p.m. to 9.30 p.m. Paint Technologist's Course, intermediate and final, 1st written, Tuesday, 3rd May, 6.30 p.m. to 9.30 p.m., 2nd written, Wednesday, 4th May, 6.30 p.m. to 9.30 p.m., and practical, Saturday, 7th May, 2.30 p.m. to 6.30 p.m. The details for the Technical Service Representative's Course, intermediate examination, are the same as for the Paint Technologist's Course, but in the final grade there is only one written paper (on Tuesday, 3rd May) as well as the practical on Saturday, 7th May.



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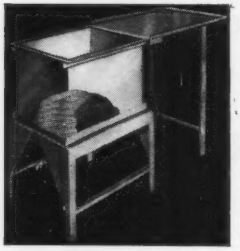

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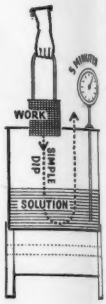

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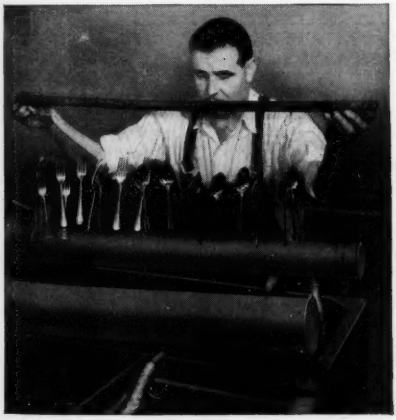

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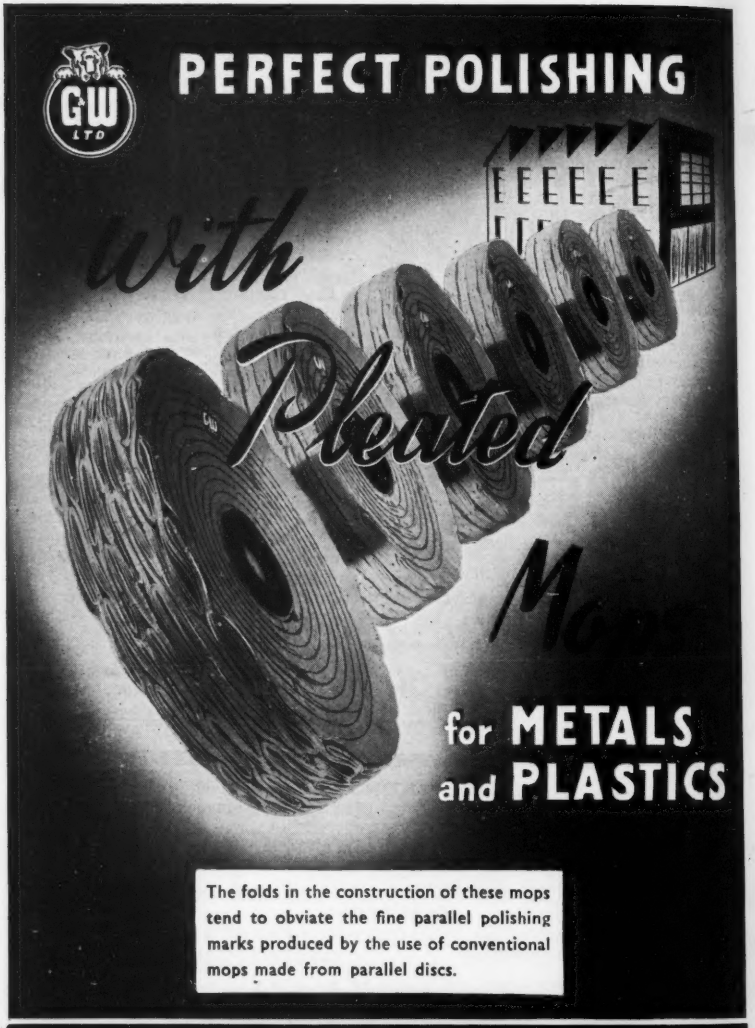
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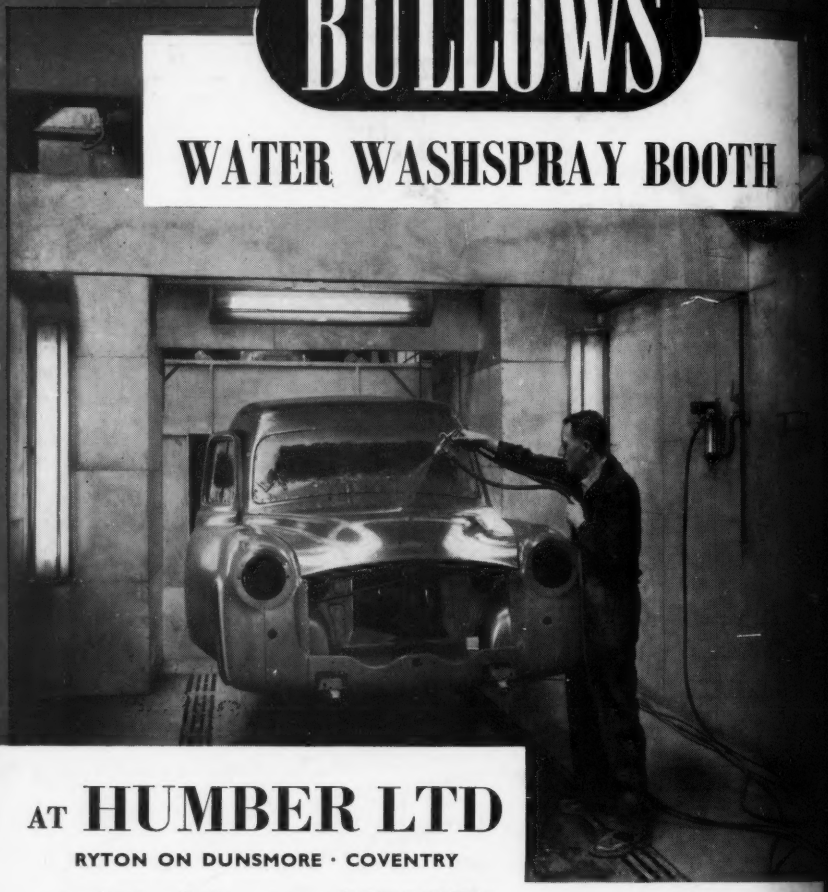

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